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TRANSACTIONS

OF THE

AMERICAN CLIMATOLOGICAL ASSOCIATION.

FOR THE YEAR 1902.

VOLUME XVIII.

"The object of this Association shall be the study of Climatology and Hydrology and of Diseases of the Respiratory and Circulatory Organs."—*Constitution.*

PHILADELPHIA:
PRINTED FOR THE ASSOCIATION.
1902.

NOTICE.

The Association assumes no responsibility for the statements and opinions expressed in the papers read at its meetings.

Copies may be had of the Secretary.

VOL. XI. contains a complete Index of 11 volumes.

DORNAN, PRINTER.

OFFICERS OF THE ASSOCIATION, 1902.

PRESIDENT.

SAMUEL A. FISK, M.D., DENVER.

VICE-PRESIDENTS.

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W. F. R. PHILLIPS, M.D., Weather Bureau, Washington.

SECRETARY AND TREASURER.

GUY HINSDALE, M.D., PHILADELPHIA.

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REPRESENTATIVE TO THE EXECUTIVE COMMITTEE OF THE CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS.

FREDERICK I. KNIGHT, M.D., BOSTON.
ROLAND G. CURTIN, M.D., PHILADELPHIA, *Alternate.*

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MEMBER OF THE COMMITTEE OF ARRANGEMENTS OF THE CONGRESS.

W. F. R. PHILLIPS, M.D., WASHINGTON.

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Henry I. Bowditch

LIST OF OFFICERS.

Presidents.

NAME.	YEAR.
A. L. Loomis	1884–5.
William Pepper	1886.
Frank Donaldson	1887.
A. L. Loomis	1888.
V. Y. Bowditch	1889.
Charles Denison	1890.
F. I. Knight	1891.
W. E. Ford	1892.
R. G. Curtin	1893.
A. H. Smith	1894.
S. E. Solly	1895.
J. B. Walker	1896.
E. Fletcher Ingals	1897.
E. O. Otis	1898.
Beverley Robinson	1899.
Abraham Jacobi	1900.
Robert H. Babcock	1901.
Samuel A. Fisk	1902.
Norman Bridge	1903.

Vice-Presidents.

F. I. Knight, W. H. Geddings	1884–5.
Frank Donaldson, Beverley Robinson	1886.
V. Y. Bowditch, R. G. Curtin	1887.
A. Y. P. Garnett, J. T. Whittaker	1888.
J. R. Leaming, E. T. Bruen	1889.
A. L. Gihon, H. B. Baker	1890.

NAME.	YEAR.
E. L. Trudeau, T. S. Hopkins	1891.
E. Fletcher Ingals, Beverley Robinson	1892.
A. H. Smith, E. O. Otis	1893.
I. Hull Platt, E. L. Trudeau	1894.
John H. Musser, G. R. Butler	1895.
Charles E. Quimby, James A. Hart	1896.
S. A. Fisk, John C. Munro	1897.
Beverley Robinson, C. F. McGahan	1898.
James A. Hart, R. C. Newton	1899.
R. H. Babcock, J. W. Brannan	1900.
Albert C. Peale, S. W. Langmaid	1901.
Norman Bridge, W. F. R. Phillips	1902.
James C. Wilson, H. S. Orme	1903.

Secretaries and Treasurers.

James B. Walker	1884–95.
Guy Hinsdale	1895.

LIST OF MEMBERS.

Honorary Members.

ELECTED

1897. Weber, Sir Hermann, 10 Grosvenor Street, W., London, England.

1897. Williams, Charles Theodore, 2 Upper Brook Street, W., London, England.

Corresponding Members.

1898. Eyre, G. G., Claremont, Cape Town, South Africa.

1898. Gache, Samuel, 729 Corrientes Street, Buenos Ayres, South America.

1898. Liceaga, Eduardo, 4 San Andres Street, Mexico.

1898. Orvananos, Domingo, 25 Chavarri Street, Mexico.

1898. Sunderland, Septimus, 11 Cavendish Place, Cavendish Square, W., London.

1902. Weber, F. Parkes, 19 Harley Street, W., London.

1898. Wragge, Clement L., Brisbane, Queensland, Australia.

Active Members.

1888. Abbot, Griffith E., 13½ Street and Pennsylvania Avenue, Washington, D. C.

1897. Alden, C. H., Assistant Surgeon-General, U. S. A. (Ret'd), 33 Washington Park, Newtonville, Mass.

1897. Alton, Charles D., 86 Farmington Avenue, Hartford, Conn.

ELECTED

1898. Anders, Howard S., 1836 Wallace Street, Philadelphia.
1899. Anders, J. M., 1605 Walnut Street, Philadelphia.
1890. Anderson, B. P., 106 North Cascade Avenue, Colorado Springs, Col.
1900. Arnold, Horace D., 188 Warren Street, Boston.

1893. Babcock, R. H., 103 State Street, Chicago.
1885. Baker, Henry B., 726 Ottawa Street, Lansing, Mich.
1898. Baldwin, Edward R., Saranac Lake, N. Y.
1901. Barlow, W. Jarvis, Wilcox Building, Los Angeles, Cal.
1898. Battle, S. Westray, Asheville, N. C.
1885. Bell, A. N., 337 Clinton Street, Brooklyn.
1896. Bergey, David H., Laboratory of Hygiene, University of Pennsylvania, Philadelphia.
1902. Bergtold, William H., 1460 Clayton Street, Denver, Col.
1896. Bernardy, E. P., 221 South 17th Street, Philadelphia.
1897. Billings, Frank, 35 22d Street, Chicago.
1897. Blackader, Alexander D., 236 Mountain Street, Montreal, Canada.
1895. Boardman, W. S., 57 Hancock Street, Boston.
1897. Bonney, S. G., 726 14th Street, Denver.
1884. Bosworth, F. H., 41 Park Avenue, New York.
1885. Bowditch, V. Y., 506 Beacon Street, Boston.
1901. Bracken, Henry Martyn, 1010 Fourth Street, Minneapolis, Minn.
1891. Brannan, John W., 11 West 12th Street, N. Y.
1894. Bridge, Norman, 217 South Broadway, Los Angeles, Cal.
1897. Brown, Sanger, Reliance Building, Chicago.
1890. Buckley, J. J., Missoula, Mont.

ELECTED

1896. Bulette, W. W., Central Block, Pueblo, Col.
1886. Butler, G. R., 229 Gates Avenue, Brooklyn.

1896. Campbell, W. A., 424 North Nevada Avenue, Colorado Springs, Col.
1898. Casselberry, W. E., 34 Washington Street, Chicago.
1894. Chapin, Frederick W., Hot Springs, Va.
1887. Chapman, S. H., New Haven, Conn.
1898. Chappell, Walter F., 7 East 55th Street, New York.
1898. Cleemann, Richard A., 2135 Spruce Street, Philadelphia.
1901. Cobb, J. O., U. S. Hospital Marine Service, care of Surgeon-General, Washington, D. C.
1894. Coleman, Thomas D., 563 Greene Street, Augusta, Georgia.
1901. Collins, Charles Farnham, 50 West 55th Street, New York City.
1889. Coolidge, A., Jr., 613 Beacon Street, Boston.
1902. Craig, R. W., Phoenix, Arizona.
1885. Curtin, R. G., 22 South 18th Street, Philadelphia.

1892. Daland, Judson, 317 South 18th Street, Philadelphia.
1890. Darlington, Thomas, Jr., King's Bridge, New York City.
1897. Davis, N. S., Jr., 65 Randolph Street, Chicago.
1884. Denison, Charles, 823 14th Street, Denver.
1897. De Witt, Calvin, Asst. Surgeon-General, U. S. A., Washington, D. C.
1884. Didama, H. D., 424 South Salina Street, Syracuse, N. Y.
1898. Dudley, E. C., 1617 Indiana Avenue, Chicago.
1902. Duffield, William, Phœnix, Arizona.

ELECTED

1897. Edson, Carroll E., McPhee Building, Denver, Col.
1892. Elsner, H. L., Fayette Park, Syracuse, N. Y.

1887. Fisk, Samuel A., 37 18th Street, Denver, Col.
1902. Flint, W. H., Santa Barbara, Cal.
1885. Ford, Willis E., 266 Genesee Street, Utica, N. Y.
1897. Futterer, Gustav, 34 Washington Street, Chicago.

1896. Gardiner, C. F., 818 North Cascade Avenue, Colorado Springs, Col.
1886. Garnett, A. S., Hot Springs, Ark.
1898. Getchell, Albert C., 6 Linden Street, Worcester, Mass.
1892. Gibson, William M., 260 Genesee Street, Utica, N. Y.
1884. Glasgow, W. C., 2847 Washington Avenue, St. Louis.
1901. Guthrie, George W., 109 South Franklin Street, Wilkesbarre, Pa.

1893. Hance, I. H., Lakewood, N. J.
1891. Hart, James A., Colorado Springs, Col.
1900. Harvey, Thomas W., 463 Main Street, Orange, N. J.
1896. Heffron, John L., 528 South Salina Street, Syracuse, N. Y.
1893. Hinsdale, Guy, 3943 Chestnut Street, Philadelphia.
1902. Hoagland, Henry W., 327 North Nevada Avenue, Colorado Springs, Col.

1884. Ingals, E. Fletcher, 34 Washington Street, Chicago.

1900. Jackson, Henry, 309 Marlborough Street, Boston.
1889. Jacobi, A., 19 East 47th Street, New York.
1888. Jayne, W. A., 217 McPhee Building, Denver, Col.

ELECTED

1901. Jennings, Charles Godwin, 457 Jefferson Street, Detroit, Mich.
1897. Johnson, Frank S., 2521 Prairie Avenue, Chicago.
1893. Judd, L. D., 3603 Powelton Avenue, Philadelphia.

1890. Kellogg, J. H., Battle Creek, Mich.
1899. Klebs, Arnold C., 100 State Street, Chicago.
1884. Knight, Frederick I., 195 Beacon Street, Boston.

1887. Langmaid, S. W., 373 Boylston Street, Boston.
1899, Le Fevre, Egbert, 52 West 56th Street, New York.
1896. Loomis, Henry P., 58 East 34th Street, New York.
1902. Lyle, B. F., Price Hill, Cincinnati, Ohio.

1902. Marvel, Philip, 1616 Pacific Avenue, Atlantic City, N. J.
1887. Mays, Thomas J., 1829 Spruce Street, Philadelphia.
1902. McBride, James H., Pasadena, Cal.
1894. McGahan, C. F., Aiken, S. C., and Bethlehem, N. H.
1899. Minor, Charles L., Asheville, N. C.
1889. Munro, John C., 173 Beacon Street, Boston.
1886. Musser, John H., 1927 Chestnut Street, Philadelphia.

1900. Nammack, Charles E., 42 East 29th Street, New York.
1895. Newton, R. C., 42 Church Street, Montclair, N. J.
1899. Norrie, V. H., 21 West 37th Street, New York.
1888. Nunn, Richard J., 119 York Street, Savannah.

1884. Orme, H. S., 214 Douglas Building, Los Angeles, Cal.
1888. Otis, E. O., 381 Beacon Street, Boston.

1887. Peale, A. C., 605 12th Street, N. W., Washington, D. C.

ELECTED

1900. Pearce, F. Savary, 1407 Locust Street, Philadelphia.

1893. Peterson, Frederick, 60 West 50th Street, New York.

1895. Phillips, W. F. R., Weather Bureau, Washington, D. C.

1885. Platt, Isaac Hull, Bryn Mawr, Pa.

1887. Platt, Walter B., 802 Cathedral Street, Baltimore.

1902. Pottenger, F. M., Bradbury Block, Los Angeles, Cal.

1891. Quimby, Charles E., 44 West 36th Street, New York.

1891. Ransom, C. C., 66 West 49th Street, New York (Richfield Springs).

1884. Reed, Boardman, 1831 Chestnut Street, Philadelphia.

1885. Rice, C. C., 123 East 19th Street, New York.

1901. Richardson, Charles W., 1102 L Street, Washington, D. C.

1893. Risley, S. D., 1824 Chestnut Street, Philadelphia.

1899. Rives, William C., 1723 I Street, Washington, D. C.

1884. Robinson, Beverley, 42 West 37th Street, New York.

1890. Robinson, W. D., 2012 Mount Vernon Street, Philadelphia.

1902. Rochester, Delancey, 469 Franklin Street, Buffalo, N. Y.

1892. Roe, John O., 28 North Clinton Street, Rochester, N. Y.

1890. Rogers, E. J. A., 222 Colfax Avenue, Denver, Col.

1889. Ruck, Carl von, Asheville, N. C.

ELECTED

1884. Schauffler, E. W., 3835 Wyandotte Street, Kansas City, Mo.

1901. de Schweinitz, E. A., 1325 H Street, N. W., Washington, D. C.

1901. Sewall, Henry, 23 Eighteenth Avenue, Denver, Col.

1884. Shurly, E. L., 32 Adams Avenue, West Detroit, Mich.

1890. Smith, A. Alexander, 8 West 47th Street, New York.

1885. Smith, Andrew H., 18 East 47th Street, New York.

1887. Smith, Frank Fremont, Palm Beach, Florida, and Bar Harbor, Maine.

1887. Solly, S. E., 2 North Cascade Avenue, Colorado Springs, Col.

1900. Stengel, Alfred, 1811 Spruce Street, Philadelphia.

1898. Stubbert, J. Edward, 25 East 45th Street, New York City.

1901. Swan, Will Howard, 706 North Nevada Avenue, Colorado Springs, Col.

1892. Taylor, H. Longstreet, 75 Lowry Arcade, St. Paul, Minn.

1896. Taylor, J. Madison, 1504 Pine Street, Philadelphia.

1885. Trudeau, E. L., Saranac Lake, N. Y.

1884. Tyndale, J. Hilgard, 13th and P Streets, Lincoln, Neb.

1884. Walker, James B., 1617 Green Street, Philadelphia.

1891. Watson, E. W., 131 North 20th Street, Philadelphia.

1895. Weber, Leonard, 25 West 46th Street, New York.

1897. Whitcomb, H. H., Norristown, Pa.

1898. Whitney, Herbert B., 726 14th Street, Denver, Col.

1898. Williams, Francis H., 505 Beacon Street, Boston

ELECTED

1898. Williams, Harold, 528 Beacon Street, Boston.

1885. Williams, H. F., 197 Gates Avenue, Brooklyn.

1884. Wilson, James C., 1437 Walnut Street, Philadelphia.

1901. Wyman, Walter, Surgeon-General, U. S. Marine Hospital Service, Washington, D. C.

Total, 139 active members.

MINUTES.

The Nineteenth Annual Meeting of the American Climatological Association was called to order by the President, Dr. Samuel A. Fisk, at 9.50 A.M., on June 9, 1902. The Rt. Rev. Joseph H. Johnson, Bishop of Los Angeles, opened the exercises with prayer. The President, Dr. Fisk, then delivered the annual Presidential Address and announced the opening of the regular programme.

The following members and guests were in attendance:

Dr. Horace D. Arnold,
Dr. W. Jarvis Barlow,
Dr. V. Y. Bowditch,
Dr. Norman Bridge,
Dr. W. A. Campbell,
Dr. R. A. Cleemann,
Dr. R. G. Curtin,
Dr. Charles Denison,
Dr. Samuel A. Fisk,
Dr. W. H. Flint,
Dr. A. C. Getchell,
Dr. James A. Hart,
Dr. John L. Heffron,
Dr. Guy Hinsdale,
Dr. C. F. McGahan,
Dr. Charles E. Nammack,
Dr. H. S. Orme,
Dr. E. O. Otis,
Dr. W. F. R. Phillips,
Dr. F. M. Pottenger,

Dr. E. A. de Schweinitz,
Dr. Henry Sewall,
Dr. S. E. Solly,
Dr. W. H. Swan,
Dr. H. Longstreet Taylor.

Guests: Dr. Walter C. Bailey, Mr. Jerome C. Cheney, Dr. W. A. Edwards, Dr. George E. Abbott, Dr. C. A. Sanborn, Dr. Walter Lindley, Dr. W. E. Parke, Dr. D. C. Romaine, Dr. H. Warren White.

The Executive Session was called to order by the President at 12 o'clock, and upon motion of Dr. Bowditch the calling of the roll and the reading of the minutes of the last meeting were dispensed with.

Dr. Hinsdale read the following report of the Treasurer and the report of the Council:

During the past year the Association has lost by death two members: Dr. W. W. Johnston, of Washington, who joined in 1886 and was our representative on the Committee of Arrangements for all the meetings in connection with the Congress of American Physicians and Surgeons, and Dr. J. T. Eskridge, who joined in 1885. Memoirs have been prepared of these distinguished members and will be included in our TRANSACTIONS.

One member has resigned and thirteen have been proposed for election at this meeting, of whom ten have been approved by the Council. If all should be elected it would raise the number to 139. The Council have dropped from the roll one name on account of non-attendance and non-payment of dues.

The Secretary has edited and had printed and issued the seventeenth volume of the TRANSACTIONS. It contains 410 pages and is the largest year's transactions yet issued by the Association. The preliminary matter was printed in Philadelphia and the principal portion in London. Our arrangement with the *Journal of Balneology and Clima-*

tology permitted the reprinting of some of our papers in London, and for this matter a rebate was allowed.

The volume cost the Society, when illustrated, bound, and delivered to members, about $550.00. Two hundred and sixty copies have been delivered to members of all grades, to libraries, and journals in the United States and abroad. In distributing the latter we have had, as usual, the courtesies of the Bureau of International Exchanges of the Smithsonian Institution, Washington. The late appearance of the volume was due in part to the failure of members to forward their papers promptly after reading and to the delay in receiving the discussion after returning it to members for correction. The fact, also, that we print abroad causes some delay, but the economy of our present arrangement is ample compensation.

The Council has met twice since the last annual meeting. On September 19, 1901, at a conference in Boston the plans for the present meeting were fully discussed and the tour of the Association outlined.

The President appointed various committees: on transportation, on invitations, on programme, on arrangements in California, on terminology, and on mineral springs, and the present meeting is the result of the labors of the officers and of the committees having the various matters in charge.

Through the courtesy of the Atchison, Topeka and Santa Fé Railroad, the Phœnix and Maricopa Railroad, and the Southern Pacific Company, the Committee on Transportation was enabled to form an itinerary which has enabled our members in attendance to see many of the health resorts and other interesting localities in New Mexico, Arizona, and California (see page xxxiii.). Unforeseen causes have rendered it necessary for us to meet at Los Angeles instead of at Coronado, as originally planned.

Among the matters of business demanding attention are

included the appointment of a member of the Committee of Arrangements for the next Triennial Congress at Washington, in May, 1903, in connection with which we will hold our next annual meeting. Delegates to the Executive Committee of the Congress were appointed at the last meeting.

The Executive Committee has requested an expression of opinion from this Association on the subject of the dinner of the Congress, and our Council has recommended that an individual dinner be held.

The President of this Association has been appointed one of the Vice-Presidents of the Fourteenth International Medical Congress, to be held in Madrid in 1903.

It will be necessary to act on a resolution offered at the last meeting providing for a change in the Constitution. The proposed changes were noted in the last volume of TRANSACTIONS. These changes are not recommended by the Council for adoption this year.

Report of the Treasurer.

The receipts of the Association have been as follows:

Balance on hand June 1, 1901	$156 35	
Received from members in payment of dues	795 00	
From other sources	47 75	
Total		$999 10

Expenditures:

For printing, John Bales' Sons and Danielsson	$489 00	
To printing, W. J. Dornan	169 29	
To stenographer	79 30	
Other expenses	156 35	
Total		893 94
Balance on hand June 1, 1902		$105 16

There is due from members about $100.

The report was regularly accepted and the Treasurer's accounts referred to the Auditing Committee.

The recommendation of the Council that a member be appointed on the Committee of Arrangements for the Sixth Congress of American Physicians and Surgeons at Washington was endorsed, and Dr. W. F. R. Phillips, of Washington, was appointed.

The President was selected as a member of the American Committee of the Fourteenth International Medical Congress, to be held in Madrid, in April, 1903, and it was resolved that in the event of his not being able to serve he should have the power to appoint an alternate. (Dr. Charles E. Nammack was subsequently appointed.)

The Council's recommendation to continue the arrangements for printing which have existed for the past two years was unanimously endorsed.

The Chair then appointed the following committees:

Auditing Committee: Drs. Arnold and Getchell.

Nominating Committee: Drs. Curtin, Bowditch, Otis, Solly, and McGahan.

Adjournment.

Tuesday, June 10th—Morning Session.

The meeting was called to order by the President at 9.30 a.m., and the announcement made that this session would be devoted to the consideration of "The Climate of California," a programme consisting of five papers on this subject having been prepared by Dr. Norman Bridge, of Los Angeles, under the authority of the Council.

"The Climatology of California," Prof. Alexander G. McAdie.

"The Climatology of the Eastern Foothills," Dr. C. A. Sanborn.

"The Climatology of the Western Foothills," Dr. George E. Abbott.

"The Climatology of the Mountains of California," Dr. Walter Lindlay.

"Littoral California," Dr. William A. Edwards.

Afternoon Session.

The Executive Session was called to order by the President at 12.15 o'clock.

The Nominating Committee made the following nominations for the ensuing year: President, Dr. Norman Bridge; Vice-Presidents, Drs. J. C. Wilson and H. S. Orme; Secretary and Treasurer, Dr. Guy Hinsdale; Member of the Council, Dr. S. A. Fisk. They were unanimously elected.

Upon the recommendation of the Council, Dr. F. Parkes Weber, of London, was unanimously elected a Corresponding Member of the Association.

An appropriation of $25 was made as the Society's contribution to the expenses of the Fourteenth International Congress to be held at Madrid.

The Council's recommendation that consideration of the establishment of a class of associate members should be deferred for one year was endorsed by vote of the Society.

The Auditing Committee reported the Treasurer's accounts as correct.

The Secretary presented letters from Drs. Jones, of Tempe, and Walker, of Philadelphia; Dr. Otis presented the regrets of Dr. Knight; and Dr. Solly spoke for Dr. Babcock, all of whom were absent. Dr. Bowditch and Dr. Solly were appointed a committee to draw up a "round robin," to be sent to these gentlemen.

The Committee on Terminology reported through Dr. Bowditch that their work was not yet completed, and upon motion of Dr. Arnold their time was extended for one year.

The following were elected active members: Dr. W. H. Flint, Santa Barbara; Dr. H. W. Hoagland, Colorado

Springs; Dr. Delancey Rochester, Buffalo; Dr. Wm. H. Bergtold, Denver; Dr. R. W. Craig, Phœnix; Dr. B. F. Lyle, Cincinnati; Dr. Wm. Duffield, Phœnix; Dr. J. H. McBride, Pasadena; Dr. Philip Marvel, Atlantic City; Dr. F. M. Pottenger, Los Angeles.

On motion, Dr. H. A. Hare's resignation was accepted, and the name of one member was dropped from the roll for non-payment of dues and non-attendance.

On the third day of the meeting, June 11th, papers were read by Drs. Hinsdale, Solly, Sewall, and Swan, and papers by Drs. Bonney, Gardiner, and Pearce were read by title.

At the business session a vote of thanks was extended to the President, Dr. Fisk, for his indefatigable services in connection with the arrangements for the meeting and for his services as the presiding officer; to Dr. Otis, Chairman of the Committee on Transportation, for his labors in planning and arranging the tour; to Dr. Knight for his services as Chairman of the Committee on Invitations, and to Dr. Baldwin for services as Chairman of the Committee on Programme. A vote of thanks was also passed to Dr. Hinsdale for his services as Secretary and Treasurer. A vote of thanks was passed to the officials of the Atchison, Topeka and Santa Fé Railroad, the Phœnix and Maricopa and Salt River Valley Railroad, and the Southern Pacific Company for courtesies extended in transportation over their lines; to F. Q. Story, Esq., President of the Los Angeles Chamber of Commerce; to the Pasadena Board of Trade; to the California Club; to the Pasadena Medical Society; to Mr. E. S. Babcock, Manager of Hotel Coronado; to the proprietor of the Westminster Hotel; to the Idyllwild Resort Company; to the Loma Linda Association; to the Pasadena and Mt. Lowe Electric Railway; to the Los Angeles and Santa Monica Electric Railway; to the Lake Tahoe Railway and Transportation Co.; to the Los Angeles Medical Society; to Dr. George F. Reinhardt,

of Berkeley, and to Dr. and Mrs. W. Jarvis Barlow and to Dr. Elizabeth A. Follansbee for courtesies extended to the Association and their guests.

The newly elected officers were then inducted to office, and after general expressions regarding the success of the meeting, the Association adjourned to meet in Washington, D. C., May 12, 13, 14, 1903.

GUY HINSDALE, *Secretary.*

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

Article I.—Name.

This Society shall be known as the American Climatological Association.

Article II.—Object.

The object of this Association shall be the study of *Climatology and Hydrology and of Diseases of the Respiratory and Circulatory Organs.*

Article III.—Membership.

Section 1.—This Association shall consist of *active, corresponding,* and *honorary* members, the former not to exceed one hundred and fifty, and the latter not to exceed ten.

Sec. 2.—Names of candidates for active membership, whose applications have been indorsed by *two* (2) active members, shall be sent to the Secretary at least thirty (30) days before the annual meeting. On approval of the Council, the applicant shall be balloted for at the annual meeting. Three (3) black balls shall be sufficient to reject a candidate. The Council shall have power to nominate active members.

Sec. 3.—The power of nominating honorary and corresponding members shall be vested in the Council. The election shall be conducted in the same manner as that for active members. Honorary members shall enjoy all the privileges of active members, but shall not be allowed to hold any office or cast any vote.

Sec. 4.—Any member of the Association absent from the meetings, in person or by contributed paper, for three (3) con-

secutive years, without sufficient cause, may be dropped from the list of members by vote of the Council.

Article IV.—Officers.

Section 1.—The officers of this Association shall consist of a *President*, two *Vice-Presidents*, a *Secretary and Treasurer*, who, with five other members and the delegate and alternate to the Executive Committee of the Congress of American Physicians and Surgeons shall constitute the *Council* of the Association.

Sec. 2.—Nominations. The officers, including the Council, shall be nominated by a committee of five (5) members, which committee shall be nominated by the President at the first session of each annual meeting, and shall report at the business meeting.

Sec. 3.—Elections. The election of officers shall take place at the business meeting. A majority of votes cast shall constitute an election.

Sec. 4.—The President, Vice-Presidents, Secretary and Treasurer shall enter upon their duties at the close of the annual meeting at which they are elected, and shall hold office until the close of the next annual meeting, or until their successors are elected.

Sec. 5.—Members of the Council, other than the President, Vice-Presidents, Secretary and Treasurer, shall hold office for five (5) years.

Sec. 6.—Vacancies. Any vacancy occurring among the officers of the Association during the year may be filled by the Council.

Article V.—Duties of Officers.

President and Vice-Presidents.

The President and Vice-Presidents shall discharge the duties usually devolving upon such officers. The President shall be *ex-officio* Chairman of the Council.

Secretary and Treasurer.

As Secretary, he shall attend and keep a record of all the meetings of the Association and of the Council, of which latter

he shall be *ex-officio* Clerk. At each annual meeting he shall announce the names of all who have ceased to be members since the last report. He shall superintend the publication of the TRANSACTIONS, under the direction of the Council. He shall notify candidates of their election to membership. He shall send a preliminary notification of the annual meeting two (2) months previous thereto, and the programme for the annual meeting at least two (2) weeks previous to its assembly, to all the members of the Association. He shall also send notification of the meetings of the Council to the members thereof. At each annual meeting of the Association he shall read the minutes of the previous meeting and of all the meetings of the Council that have been held during the current year.

As Treasurer, he shall receive all moneys due, and pay all debts therewith. He shall render an account thereof at the annual meeting, at which time an auditing committee shall be appointed to report.

ARTICLE VI.—COUNCIL.

The Council shall meet as often as the interests of the Association may require.

Four (4) members shall constitute a quorum.

It shall have the management of the affairs of the Association, subject to the action of the Association at its annual meetings.

It shall consider the claims of candidates recommended to it for admission to membership.

It shall not have the power to make the Association liable for any debts exceeding in total one hundred dollars ($100), in the course of any one year, unless specially authorized by a vote of the Association.

It shall have the entire control of the publications of the Association, with the power to reject such papers or discussions as it may deem best.

It shall have power to nominate active members at the annual meeting.

The Council shall have power to invite any gentleman, not a member, to read a paper at the annual meeting, on any subject within the scope of the objects of this Association.

The Council shall determine questions by vote, or—if demanded—by ballot, the President having a casting vote.

The Council shall constitute a Board of Trial for all offences against the Constitution and By-Laws, or for unbecoming conduct, and shall have the sole power of moving the expulsion of any member.

The President, or any two members, may call a meeting, notice of which shall be transmitted to every member two (2) weeks previous to the meeting.

Article VII.—Papers.

Section 1.—The titles of all papers to be read at any annual meeting shall be forwarded to the Secretary not later than one (1) month before the first day of the meeting, in order to appear on the printed programme.

Sec. 2.—No paper shall be read before the Association which has already been printed or been read before another body.

Article VIII.—Quorum.

A quorum for business purposes shall be ten (10) members.

Article IX.—Amendments.

This Constitution may be amended by a four-fifths ($\frac{4}{5}$) vote of all the members present at an annual meeting, provided that notice of the proposed amendment has been printed in the notification of the meeting at which the vote is to be taken.

BY-LAWS.

1. Meetings of the Association shall be held annually.

2. The time and place of the meetings shall be determined by the Council.

3. The dues of active members shall consist of an annual assessment not to exceed five ($5) dollars. The initiation fee shall be ten ($10) dollars. Members in arrears shall not be

entitled to vote. Those in arrears for two (2) years may be dropped from membership by recommendation of the Council.

4. Order of business meeting.

First day:

Calling the roll of members;
Minutes of previous meeting;
Treasurer's report;
Appointment of auditing committee;
Appointment of nominating committee;
Report of Council on recommendations for membership.

Second day—Morning session:

Report of nominating committee;
Election of officers;
Election of members;
Report of the committee on health resorts;
Miscellaneous business;
Adjournment of business meeting.

Any of these By-Laws may be amended, repealed, or suspended by a two-thirds vote of the members present at any meeting.

OBITUARY.

Dr. Jeremiah T. Eskridge.

Dr. Jeremiah T. Eskridge, who had been a member of this Association since 1885, died in Denver, Colorado, January 15, 1902.

Dr. Eskridge was born in Delaware on June 1, 1848. He was graduated from Jefferson Medical College in 1875, and remained in Philadelphia until 1884. During these years he continually pursued a most strenuous medical life, doing much hospital work and teaching in several of the medical educational institutions in that city. Through this work he contracted tuberculosis, for which he went to Colorado in 1884. He remained and worked in Colorado Springs from 1884 until 1888, when he removed to Denver, where he resided until his death. He never fully recovered the health lost in Philadelphia; but, in spite of physical infirmities, his life and work were such as to make his record one that holds the admiration and respect of all who knew him, and one that is equalled by few in this country.

Energy, ability, and concentration characterized his every effort and enabled him to achieve definite results in many directions.

Early in his medical career neurology became his chief interest, and in this department he did his best work. With neurology he coupled medical jurisprudence, and in the various phases of these subjects he attained a wide

reputation with both the medical and the legal professions and with the educated public.

On mental science and medico-legal subjects he published over one hundred and seventy separate articles, most of which were records of detailed observation and careful investigation. Indeed, no better illustration of his enthusiasm and energy can be cited than the fact that he left unpublished articles intended to be read at this year's medical meetings, including his address as Chairman of the Neurological Section of the American Medical Association.

His work and character early brought him recognition by the courts as an authority in his branches, and his advice was sought for and followed by them in many such cases. He did much to elevate the standing of the medical expert witness and to increase the public respect for his profession.

In everything he undertook he threw that forceful interest which was his marked characteristic, and there was no subject upon which he would give an opinion but that it was worthy of consideration.

Owing to his strong personality and a peculiar adaptability for his chosen work, his position was unique and enviable, and his death came as an irreparable loss to all those associated with him, both within and outside of his profession. Indeed, his loss is felt by the community in which he lived as nothing short of a public calamity.

THE TOUR OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION.

The annual meeting of this Association was held at Los Angeles, California, on June 9, 10, 11, 1902, and enabled the members in attendance to make a most interesting and instructive trip through Kansas, Colorado, New Mexico, Arizona, California, and Utah. Some of the members returned via Oregon, Washington, Puget Sound, and the Dominion of Canada. The arrangements provided for a private car leaving Chicago on May 27 by the Santa Fé route via Kansas City, La Junta, and Las Vegas. As might have been expected from the presence of climatologists and a direct representative of the Weather Bureau from Washington, the Association encountered *en route* what was invariably termed the "most unusual weather." There were severe floods in Western Kansas and Eastern Colorado by which several railroad bridges were carried away and which enabled us to test during forty hours of delay the tenacious qualities of Kansas mud and to become familiar with the habits of the prairie dogs and the flora and fauna of the plains. Kansas did not make a favorable impression on the party, either in the matter of soil or rainfall.

On entering Colorado Pike's Peak came into view and the interesting ranches from Nepesta and Rocky Ford, famous for its cantaloupes, to La Junta. Passing southward through New Mexico, we breakfasted at Las Vegas, where the Santa Fé road has built a beautiful hotel in the Spanish style, well appointed and under the Harvey man-

agement. At Albuquerque, at the new Hotel Alvarado, unusually good accommodations are provided. The clear, dry air and blue sky, the power of the mid-day sun, and the relative cool of the shade, the Indians, and interesting Pueblo villages made a vivid impression on the travellers. The important health stations in Southern New Mexico, including Las Vegas, Las Vegas Hot Springs, and Albuquerque, are like those in Southern Arizona and the interior of California, very comfortable for six months of the year; but from May to October they are generally abandoned for more northern stations in the table lands having 6000 or 7000 feet altitude.

The Grand Canyon of the Colorado was visited on June 1st. The river rushes through a channel one hundred and twenty-five miles long and has cut its way 5700 feet below the rim of the canyon. The Bright Angel Hotel is within a few hundred feet of the end of the railway track and is close to the edge of the precipice. Mounting horses and mules, we began the descent by a narrow and hazardous trail; we rounded "Cape Horn" and made other perilous passages, encouraged by our guides and with implicit confidence in the imperturbable beasts that hung their heads over the most awful chasms imaginable. Beginning at the top of the plateau, which belongs to the carboniferous period, the geological formations exposed in the canyon are: cherty limestone, 240 feet; upper aubrey limestone, 320 feet; cross-bed red sandstone, 380 feet; lower aubrey sandstone, 400 feet; red wall limestone, 1500 feet; lower carboniferous sandstone, 550 feet; quartzite base of carboniferous, 180 feet; archaean, 1200 feet. The river is, therefore, 5720 feet below the plateau's rim, and it is 1300 feet above tide at this point. It is to be remembered, also, that above 10,000 feet of permian, mesozoic, and tertiary formations originally held a place above the plateau as it now exists. There is no other place on the

GENERAL VIEW, GRAND CANYON OF THE COLORADO

globe where such a marvellous illustration of the formation of the earth's crust may be found. The period of time during which the process of erosion has been slowly at work in the production of this stupendous chasm is entirely beyond our conception.

The ascent of the trail would appear impossible; there are apparently impassable barriers in all directions. But the narrow path has been constructed with skill and in such a substantial manner that no accidents have hitherto occurred. As the ascent is made one realizes still more the grandeur of the canyon, and, with less anxiety for his safety, can contemplate the scene with feelings which baffle description.

A great deal of confusion has arisen because the term "Grand Canyon" has been also applied to the canyon of the Yellowstone and to the gorge of the Arkansas River in Colorado; in the latter case the term "Grand Canyon of Colorado" is sometimes used, and travellers are confused and deceived. The Grand Canyon of the Colorado River is in Northern Arizona, and is a tremendous break in the plateau, about twelve miles across from rim to rim. As one looks up and down for twenty or thirty miles along this vast chasm he "sees the great space filled with gigantic architectural constructions, with amphitheatres, gorges, precipices, walls of masonry, fortresses terraced up to the level of the eye, temples mountain size, all brilliant with horizontal lines of color—streaks of solid hues a few feet in width, streaks a thousand feet in width; yellows, mingled white and gray, orange, dull red, brown, blue, carmine, green—all blending in the sunlight into one transcendent suffusion of splendor."

The hotel is reached in about eight hours after starting, and near it there are places where one may get a glimpse of the river and watch the changing lights and shadows as evening comes on. The scene is one of marvellous

beauty, weird, mysterious, and one that might well have held us for many days. It is gratifying to know that a new hotel to cost upward of $100,000 will be erected during the winter near the rim of the canyon. The elevation of nearly 7000 feet and the delicious air at all seasons make the vicinity of the canyon a most desirable station, especially during the summer. The sandy soil supports a growth of pines and other evergreen trees; but all water has to be brought up by train from lower levels.

The United States Geological Survey will publish during the coming year atlas sheets covering the entire extent of the canyon proper and considerable areas on either side. It will show every pinnacle, spur, and gully in its true proportions, and each line of cliffs and terraces may be traced along the canyon walls.

The dimensions of the Grand Canyon have been the subject of much discussion ever since it was first explored by the late Major Powell. It may, therefore, be of interest to give some figures taken from this new survey. The average width from rim to rim does not exceed ten miles throughout the Kaibab, or widest section of the canyon, and frequently narrows down to eight miles. The river does not occupy the middle of the gigantic trough, but flows at a distance varying between one and three miles from the south side. Practically all of the magnificently sculptured pinnacles and mesas (the so-called temples) lie north of the river and at distances of from five to seven miles from the viewpoints usually visited by tourists. The depth of the Grand Canyon in one way has been overstated, in another understated. Measured from the south rim, the total depth is considerably less than a mile. From the rim at the Bright Angel Hotel, where the altitude is 6866 feet above sea level, to the high-water mark of the river at the foot of the tourist trail the drop is 4430 feet. The highest point on the south rim at the Grand View Hotel is 7496 feet, about 4900 feet above the

ASCENDING BRIGHT ANGEL TRAIL, GRAND CANYON OF ARIZONA

river. From the north side, however, the drop to the water level averages considerably over a mile, and in many places even exceeds 6000 feet. It may be stated in a general way that the north rim is from 1000 to 1200 feet higher than the south, thus producing that high, even sky-line so striking in all views obtainable by the tourist. The figures here given are based on the spirit-levels run in connection with the map work. They are the first that have ever been run to the bottom of the chasm, and the high standard of accuracy maintained throughout will cause them to be considered authoritative and final.

On reaching Ash Fork, in Arizona, the Association was welcomed to the Territory by Dr. Duffield, Dr. Foss, and Dr. Plath, physicians representing the Medical Society of Arizona and the Board of Trade of Phœnix. During our visit of several hours at Prescott (altitude 5000 feet) we were driven about the town and visited the excellent hospital conducted by the Sisters of Mercy. At Phœnix we were cordially received and handsomely entertained. The morning was devoted to driving through the city and its environs, visiting the Indian school and the Capitol, where we were received by the acting Governor of the Territory. The temperature at Phœnix on the day of our visit was 100° F. in the shade, but the heat was not exhausting, as the relative humidity was 5 per cent. After an enjoyable dinner at the Hotel Adams, tendered to the Association by the physicians of Phœnix and by the Board of Trade, we listened to a description of the climate of Arizona by Mr. William G. Burns, the Section Director of the United States Weather Bureau (see TRANSACTIONS). The Hon. Webster Street acted as toastmaster, and toasts were responded to by Dr. Bowditch, Dr. Phillips, Dr. Otis, Dr. Solly, Dr. Nammack, Dr. Cleemann, Dr. McGahan, Dr. Duffield, and Dr. Taylor. After dinner the members visited the station of the Weather Bureau.

A few miles below Phœnix an opportunity was afforded

to visit Tempe, a beautiful station on the Maricopa, Phœnix, and Salt River Valley Railroad. Dr. Jones, of Tempe, met us with conveyances and showed us the country round about. The rich soil and broad fields of alfalfa and the extensive agricultural interests made a lasting impression on the members of the party.

On regaining the railroad our car was taken, through the courtesy of the Phœnix and Maricopa Railroad, to Maricopa, where it was attached to the overland train of the Southern Pacific Company, to which our thanks are due for courtesies of transportation throughout California. The company sent as its representative Dr. George F. Reinhardt, of Berkeley, California, who met us at Loma Linda and accompanied the Association throughout the State, and who facilitated our movements and in every way added to the interest and usefulness of the trip. At Loma Linda the Association was welcomed by the Riverside County Medical Society and the Redlands Medical Society and the Board of Trade. We thoroughly enjoyed the quiet beauty of the surroundings.

The orange groves were still bearing fruit, and the beautiful gardens and quiet restfulness of the place were particularly grateful to all. We were taken to Redlands and driven through that beautiful city to Smiley Heights and Canyon Crest, where we saw the most luxuriant foliage and a paradise of flowers. Redlands is a comparatively new city, dating from 1887. It now has a population of about 6500, and is one of the most beautiful places of residence on the Pacific coast. Many of the handsome estates are owned by Eastern people, who visit Redlands during the winter and early spring. Smiley and England Heights are beautiful at all seasons, and are kept in order by a small army of caretakers. Redlands has an almost level valley south of the Mohave desert and between the San Bernardino, San Gorgonio, and San Antonio Mountain ranges. There are about 4500 acres devoted to orange groves, from

COUNTRY AROUND PHŒNIX

AN ARTIFICIAL WATERWAY NEAR PHŒNIX

which 2443 carloads of fruit were shipped in 1901. The ranches are scientifically graded so as to employ irrigation, as the average rainfall is only 16.8 inches, ranging from 7.81 inches in 1898, to 25.7 inches in 1899. The groves are in fine order, and are well fertilized to maintain their excellence.

A dinner was tendered to the Association in the evening of June 4th by the Loma Linda Association, the Redlands Medical Society, and the Board of Trade, to which a number of the physicians of Riverside, Redlands, and Los Angeles were invited.

The toastmaster was the Rev. R. McIntyre, D.D., of Los Angeles, who welcomed the Association to California and to its first taste of California hospitality. After reference to what the great railroads had done for California, and showing that cities are now built where men find it most congenial to live, Dr. McIntyre paid a glowing tribute to the climate of California, picturing the scenery of the Yosemite and Mt. Shasta, and declaring that Southern California had the best "all-the-year-round" climate in the world. "You may assert that all places have climate. No; I have known cities having no climate—only weather. Here the climate is tempered to bear a kindly demeanor toward man. You will find here something else besides. You will find a wonderful people. It seems to me that God has sifted forty States to get the seeds to plant Southern California with men."

Responses were made by Dr. W. F. R. Phillips, Vice-President of the Association, who gave an account of the journey from the East, and spoke in appreciation of the welcome extended to the Association. Other responses were made by Mr. Henry B. Ely, of Redlands, Dr. McCoy, of Los Angeles, and Dr. S. E. Solly.

On the following day, June 5th, we went to Riverside, accompanied by physicians of Riverside, and were driven in tally-hos, provided by the Chamber of Commerce,

through Magnolia Avenue and through some of the beautiful estates. At Chemawa Park a delicious luncheon was served by the ladies of Riverside. Riverside possesses some of the oldest orange groves in California, and the ranches have been brought to a very high state of cultivation. With ample irrigation, enriching the soil, and with constant attention to the needs of the various fruit trees, the owners of these orchards have obtained a handsome return; 5000 carloads of oranges were shipped last year. Riverside dates from about 1870; the famous navel orange was first grown in the United States at Riverside, about ten years ago. Olives, lemons, the date palm, and other palms flourish. The valleys are nearly level in this part of California, lying between the Sierra Madre, San Jacinto, San Gorgonio, and other mountains, and, where water is introduced, are easily irrigated, and the finely pulverized, chocolate-colored volcanic soil and decomposed granites are wonderfully productive. Owing to the long dry season, dust becomes objectionable; but on the principal avenues of all towns in Southern California oil is now used to lay the dust and harden the roadbed. A large supply of oil in Southern California makes this possible, and the streets are sprinkled with crude petroleum several times during the season. As the oil becomes well incorporated with the roadbed a firm and dustless road is the result. The odor of the crude oil becomes less and less obnoxious. Some of the oil fields of California extend under the sea, and at Santa Barbara wells are driven hundreds of feet from the shore, and through pipes the oil is collected. On leaving Riverside we went to Hemet *en route* for Idyllwild. Hemet is on the Santa Fé Railway, thirty-five miles southeast of Colton. We were entertained at lunch by the Hemet Land Company, and by them driven to Idyllwild, a health resort in the Strawberry Valley, twenty miles distant, at an elevation of 5250 feet. The last ten miles was up a steep mountain road. The resort is pri-

BAKERSFIELD AVENUE, REDLANDS

MAGNOLIA AVENUE, RIVERSIDE

marily for the reception of tuberculous patients, and there were fifty under treatment at the time of our visit. The establishment consists of a central building, conducted like a hotel, with a large number of cottages and tents at convenient locations. There are electric and steam plants, good water supply, and 7000 acres of land, including the Strawberry Valley. The Strawberry Valley Lodge is half a mile from the Sanatorium. It is under the same general management and equipment, at less cost. We enjoyed the hospitality of Idyllwild for two nights and a day, and had the opportunity of exploring on horseback the surrounding heights.

We reached Los Angeles on June 8th, and during the succeeding three days held the scientific sessions. Twenty-two papers were presented and are printed in the annual volume of TRANSACTIONS. The feature of the second day was the presentation of five papers on California: Prof. Alexander McAdie, of the Weather Bureau, San Francisco, contributed a paper on the climate of California in general; Dr. C. A. Sanborn, of Redlands, on the climate of the Eastern Foothills; Dr. G. E. Abbott, of Pasadena, on the climatology of the Western Foothills; Dr. W. A. Edwards, of Colorado, on Littoral California; and Dr. Walter Lindley read a paper on the climatology of the mountains of California.

The annual dinner was held at the Westminster Hotel, and sixty participated. While the dinner was being held the ladies accompanying members of the Association were entertained by ladies of Los Angeles with an enjoyable musical entertainment. A fine musical programme added to the enjoyment of the annual dinner, and a handsome illustrated souvenir entitled "Climate: What it Means," was presented to each guest by the Los Angeles Chamber of Commerce.

Dr. Charles E. Nammack, of New York, in responding to a toast, "The Statue of Liberty," paid California a glowing

tribute. He said the freedom of the West eclipsed all New York's ideas of liberty, and that "hereafter Southern hospitality, which has hitherto been our synonym for generosity, must give place to Western open-heartedness."

"When, a few days ago," he continued, "a band of Eastern tourists, cooped up for nine nights in Pullman sleepers, were landed in your beautiful San Bernardino Valley, after a tiresome night and day crossing the desert, they felt, indeed, that here was the Garden of Eden. Later in the day they discovered that Eve was not only well represented here, but that she possessed all those attributes which made the original Eve irresistible to Adam and her successors dangerous to his descendants. But you men of California have, we observe, taken the precaution to secure a more permanent tenure of office than Adam enjoyed. You have carefully refrained from cultivating the apple, and, following the example of the patron saint of another beautiful country, you have banished the serpent. Without her historic accomplices before the fact, your Eve may be powerless for evil, but she is not powerless for good. As we look into her clear, bright eye, and admire her rosy and sun-kissed cheek, we feel that she matches your beautiful country, and the gold of your oranges only typifies the gold of her heart. Long may she live with you, the fairest flower in the garden of our American Italy, where nature seems to work with man and not against him.

"And what a history of varied experiences has been that of your country! First, the romance period of the Spanish voyagers of the sixteenth century, whose easy indolence and everlasting manana only enabled them to admire, but not to acquire, the land. Then the period of pastoral life, established by that wonderful band of Franciscan fathers, who taught two commandments, love of God and love of our neighbor; but upon these two commandments hangs all the law. The story of their

IDYLLWILD SANATORIUM, STRAWBERRY VALLEY, RIVERSIDE CO., CAL.

COTTAGES AT IDYLLWILD SANATORIUM, CALIFORNIA
Elevation, 5250 feet

trials, sufferings, and final triumph is also a romance; but, alas! a romance with a tragic ending. The coming of the American desperado and land-grabber about 1840 ended the Franciscan rule and ushered in a period of lawless adventure and land-robbing which is a blot upon the fair fame of our government. Next came the period of chance experiment and crazy speculation, when men's minds were influenced by the apparently limitless possibilities, and when Southern California was a succession of boom towns on paper. But the wildest speculation could not take from the country its characteristics. It left the climate as it was, the fertility as it was, and the value of arable land not reduced.

"You have now entered upon the final period of solid, civilized development, and, with the enormous increase of your business enterprises, you will have time for the cultivation of art, music, literature, and that external beauty of your homes and towns which is the delight of the Eastern eye. One need not be an invalid nor a physician to come here and appreciate the graciousness of the air, the color of the landscape, the constant procession of flowers, the purple hills stretching into the sea, the picturesque homes in this region of marvellous beauty. But one must be a physician from the bleak Atlantic seaboard to feel the longing in his heart to carry some of your sunshine into the sick rooms of his Eastern patients. Quinine, strychnine, iron, and other drugs compounded by our chemists we can carry in, but the marvellous sunshine of the Almighty Alchemist is compounded—we know not how. We only know that in His infinite mercy it is showered upon your land and your people. Compared with this glorious sunshine, all the other elements which go to make up what we call climate are as nothing. It is the sun that enables your State to be at once the land of the pine and the palm, those widely separated lovers of Heine's song.

"We working physicians of the East, who have been living for the rest of the year on the tap of a bell, who have been eating with the unpleasant knowledge that someone was waiting in the office, and sleeping with the fear that the night summons would break in at any moment, we admire this land where hurry and petty feverish ambition are lessened, where there is a little more serene waiting on Providence, an abatement of the restless rush and haste of our usual life. In your land of the sun, of the mountains, of the sea, you have the fairest field for a contented community without any poverty and without excessive wealth. We leave you with regret and with the acknowledgment that the bigness of your country is only paralleled by the bigness of your hearts."

On the following evening Dr. and Mrs. W. Jarvis Barlow gave a reception at their residence to the Association, and invited the Los Angeles Medical Society to meet the members and accompanying ladies and guests.

The courtesies of the California Club were extended to all the members and accompanying guests, and this attention was highly appreciated. Dr. Le Moyne Wills, Dr. George L. Cole, Dr. Bridge, Dr. Orme, and others entertained members at luncheon and took all the members of the Association in tally-hos about the city of Los Angeles and its environs. We were shown the Medical Department of the University of Southern California, the Children's Hospital, the Sisters' Hospital, the new Sanatorium for the Tuberculous Poor, and the California and Pacific Hospitals. The Association made an afternoon trip to Santa Monica by courtesy of the electric road, and several of the members took their first dip in the waters of the Pacific Ocean. The strong afternoon sea breeze created a pretty heavy surf, and the temperature of the water was not over 60° F. Santa Monica is a popular seashore resort seventeen miles from Los Angeles, and has two very good hotels and numerous small cottages.

AT SANTA MONICA

GREAT INCLINE, MT. LOWE

An afternoon was spent in a trip to Pasadena and Mt. Lowe. The Association was welcomed to Pasadena by the Board of Trade and driven over its beautiful avenues. The private residences in Pasadena are of a high grade, many of them of great architectural beauty and with attractive grounds. The palms, the pepper trees, the rose hedges, and beautiful lawns make Pasadena one of the most desirable places of residence; but here, as elsewhere in Southern California, many of the houses were deserted and will not be opened until January. Pasadena is not, however, unsuited for residence all the year round. The temperature in summer may reach 90° F. or over, but the relative humidity at the same time is about 40 per cent. The humidity is greater, however, than at Redlands, San Bernardino, and other interior stations. The nights are always cool, and blankets are indispensable. In winter the temperature rarely falls to 26° F., and the days are warm and sunny. On New Year's day the tournament of roses is one of Pasadena's beautiful sights. We visited the new Hotel Raymond and made a call at the home of Dr. Norman Bridge, Vice-President of the Association. By the courtesy of the Pasadena and Mt. Lowe Electric Railway a trip was made to the Alpine Tavern, 1000 feet from the summit. The ascent is made partly by electric and cable power, and affords a fine view of Pasadena, San Rafael Heights, and the San Gabriel Valley. The afternoon fog near the coast prevented a clear view of the ocean. It was a beautiful trip, and is one of the most remarkable pieces of engineering. The elevation reached was 5000 feet.

On June 12th the Association, having finished its sessions, left via the Santa Fé Road for San Diego and Coronado. Here the visiting members were welcomed by Dr. William A. Edwards and Mr. E. S. Babcock, manager of Hotel Coronado, and delightfully entertained. It had been the intention of the Association to hold its meeting at

Coronado, but unforeseen difficulties arose which made it necessary to hold the sessions at Los Angeles, and visit Coronado afterward. Coronado is unquestionably the best seashore resort on the Pacific coast, and it is equally enjoyable in winter as in summer. The bathing, fishing, games of water polo, and other diversions render a visit to Coronado particularly delightful.

Returning to Los Angeles, the Association made a trip to Catalina Island, remaining overnight at Avalon. The island is reached by a sail of twenty-three miles from San Pedro. Avalon is protected from high winds and surf, and is an ideal place for sailing, fishing, and for studies of the marine fauna and flora. The sea lions are always interesting. Sea bass weighing over 400 pounds are occasionally caught from Avalon; tuna, jewfish, barracuda, and halibut are also found in these waters.

Returning to Los Angeles, the Association visited Santa Barbara. From San Buenaventura the train followed the shore and traversed a most interesting oil district. The innumerable derricks extended to the water's edge, and at one point piers were constructed beyond the breakers, so that the remarkable sight was presented of oil wells in operation at some distance from the shore, from which oil may be loaded directly into tank steamers. The oil is said to flow more freely during flood tide, and the oil-bearing sands extend several miles beyond the shore line. The oil has supplanted coal for locomotives in Southern California, and during the dry season is used for sprinkling the highways to prevent dust. The oil is dark and heavy and has not yet been successfully refined. Its use on the roads and avenues of the larger cities is not offensive, and produces a good roadbed and a welcome change from the inevitable dust of the arid regions.

Santa Barbara is one of the most attractive cities of California. In front of it lies the Pacific Ocean, with a chain of islands in the distance. These break somewhat

CIRCULAR BRIDGE, MT. LOWE RAILWAY

PASADENA AND THE SIERRA MADRE MOUNTAINS

the force of storms, and the harbor is a fairly safe one. Back of the city are the Santa Inez range of mountains and the Sierra de San Rafael. By the courtesy of Dr. W. H. Flint we were driven for eighteen miles along the mountain side in and out of the canyons, which reach upward from the foothills. We also visited the interesting Santa Barbara Mission, founded by the Franciscan fathers in 1786, and which is in excellent preservation.

The coast line at Santa Barbara lies almost east and west, and the protection afforded by the mountain ranges on the north gives to Santa Barbara a most advantageous position. It is a popular place for residence during the winter and spring, and there are numerous cottages and good hotels. The Montecito Valley is an ideal place for invalids.

San Luis Obispo, the Sycamore Hot Sulphur Springs, and Paso Robles were also visited, and on the evening of June 18th we arrived at Del Monte, Monterey. The approach by way of Castroville and the vast ranches of the Salinas Valley gives no suggestion of the beauties of Del Monte. This magnificent estate, on which over two and one-half millions of dollars have been expended, is one of the "show places" of California. Although less than two miles from Monterey, there is no view of the bay, the hotel lying in a sheltered position, well surrounded by trees and gardens. There is no end of walks, and a drive of eighteen miles within the limits of the property is one of the most beautiful on the Pacific coast. Monterey Bay, the old Mission, the shores of the Pacific, and the remarkable trees are among the features of this resort. Some of the party enjoyed a sail on Monterey Bay. There is an atmosphere of restfulness and quiet beauty at Del Monte which makes it a desirable place for convalescents from acute disease. It is not specially suited to tuberculous cases.

The party left Del Monte on June 20th for Santa Cruz, and visited the remarkable grove of big trees (Sequoia

sempervirens). We proceeded to San José and made the ascent of Mt. Hamilton (elevation 4440 feet) by a long stage ride. On the following day Palo Alto was visited. The Leland Stanford, Jr., University, although not in session, was inspected, and the adjoining estates, including the late Senator Stanford's famous stock farm, were visited.

San Francisco was reached on June 21st, and the Palace Hotel was made headquarters. The visiting members of the Association were received most hospitably by leading members of the profession in San Francisco, and delightfully entertained at the Pacific-Union, University, and Bohemian Clubs. Visits were made to the U. S. Military Hospital at the Presidio, and the Sutro Baths, the Cliff House, and "Chinatown." The Association for the Protection of Forests and Waters gave a luncheon to the members, which was highly appreciated. The Association received the courtesy of a trip to the summit of Mt. Tamalpais, on the north side of the bay, the skill of the engineers who built this remarkable road and the beauty of the prospect from the summit making a decided impression. The Pacific Ocean was well seen beyond the Golden Gate, and San Francisco, Oakland, and San Rafael were plainly visible.

San Francisco has a climate of its own, with very little change through every season of the year. There is never snow or ice, and rarely any maxima over 75° F. At the time of our visit overcoats were usually required in the afternoon, especially when riding over the hills of the city. These would be impassable if ice should form. The climate is a good one for many nervous diseases, but is rather too harsh for pulmonary or bronchial affections.

On leaving San Francisco the company was somewhat divided, the majority returning east via the Southern Pacific Company's Ogden Line. This afforded an opportunity to make a side trip from Truckee to Lake Tahoe. This superb

lake, on the dividing line between California and Nevada, has been formed in the crater of an extinct volcano. It is 1645 feet deep, twelve miles wide, twenty-one miles long, and has an elevation of 6200 feet. It is of remarkable beauty, and well repays one for a visit. The Lake Tahoe Railway and Transportation Company invited the Association to visit the lake as its guests.

The members visited Salt Lake City, bathed in the Great Salt Lake, and visited the well-known places of interest.

Glenwood Springs, Colorado, was visited. This resort has an elevation of 5600 feet, and is about 160 miles west of Denver, lies in a protected valley in the midst of the foothills of the western slope of the Rocky Mountains. The annual rainfall, including snow, is 15 inches. The sheltered situation of Glenwood makes it an admirable winter resort. High winds are rare, and dust, so common on the eastern slope of the mountains, is absent. There are a large salt-water pool and fifty thermal mineral springs. A few of these, yielding about 2000 gallons of water a minute, are utilized. The temperature of the water is 127° F., and its solid contents, 1250 grains in a gallon. Carbonic acid gas and sulphuretted hydrogen are given off in large amount. There are vapor caves in which the temperature of the air is maintained at 112° F. by the heat given off from the water. The internal use of the waters is combined with douches, massage, tub- and vapor-baths, and swimming pool in treating the gouty and rheumatic conditions, gastro-intestinal and hepatic catarrh, and torpor. The waters favor recovery from syphilis and diseases of the skin. They are counter-indicated in organic disease of the kidneys complicated by degenerative changes in the arteries or by hypertrophy of the left ventricle, valvular lesions of the heart with poor compensation, or diseased bloodvessels, epilepsy, acute inflammatory diseases, recent hemiplegias, menorrhagia, or metrorrhagia.

Patients with compensated valvular lesions, unaccompanied by renal or vascular complications, suffer no inconvenience.

About twelve members reached Colorado Springs Saturday night, June 28th, and were entertained by the El Paso County Medical Society that night with a smoker. On Sunday morning a drive was given by the local members of the Association, Drs. Solly, Gardiner, Campbell, Anderson, Swan, Hart, and Hoagland. They first visited the proposed site of the new sanatorium, "Crag-Moor," of which Dr. Solly is to be the head. It is but three miles northeast of the city, located at the foot of Austin Bluffs. The sanatorium will have a southern exposure, giving plenty of shelter and an excellent view of the mountains. They were then driven to "Glen Eyre," the country home of General Palmer, who has given $50,000 toward the new sanatorium; afterward through the famous "Garden of the Gods" to Manitou Springs. A dinner was given by the local medical men with covers for thirty-five at the Antlers Hotel on the return of the party to Colorado Springs. In the afternoon Dr. Anderson chartered a trolley car and took the Society out to Broadmoor, the handsome suburb of Colorado Springs, and tea was enjoyed at the Casino. At night the party left for Denver.[1]

A glad but battered remnant of the climatologists reached Denver in the first small hour of July 1st. A railroad blockade which had delayed the party was submitted to with the resignation of experience. The Denver members of the Climatological Association hastened to extend fraternal greetings to the travellers, and seemed to succeed in making them feel that this was their country and their home for the few hours of their stay. A forenoon was delightfully passed in viewing the "Queen City

[1] The notes on Colorado Springs and Denver were furnished to the Secretary.

CORONADO AND TENT CITY

of the Plains" from the top of a tally-ho coach. The trip included an inspection of that unique institution the "Oakes Home" for consumptives, and terminated at the University Club, where a round table luncheon was served on the veranda within view of the Rocky Mountains. Several members and guests of the Association who had during the vicissitudes of the excursion found no post-prandial opportunity to express themselves were here stimulated to speak from the heart out.

The expressions of welcome, good cheer, and fraternal feeling were exceedingly hearty on the part of the Denver members of the Association. The same day the ladies were entertained at the residence of Mrs. Sewall.

The remaining hours of the evening were passed as best liked by the individual members in visiting the cathedral, the clubs, the library, or in wooing surcease of weariness.

The returning guests left that night by the Chicago, Rock Island and Pacific Railway, which courteously furnished transportation for the party.

Some of the members of the Association, including the Secretary, went north from San Francisco by the famous Shasta Route, passing close to that magnificent snow-covered mountain. We visited Portland, Tacoma, and Seattle, going thence by steamer up Puget Sound to Vancouver, B. C.

Mount Shasta is an extinct volcano, 14,440 feet high, and is visible during six hours of railway travel. At Shasta Springs we left the train for a short time to taste the delicious water and enjoy the picturesque surroundings of the mountain slope. Shasta water is a carbonated, slightly saline water, resembling Apollinaris. It is an agreeable table water, and is widely sold on the Pacific coast. Northern California abounds in valuable mineral springs, among which are Napa Soda Springs, Klamtah Springs, and the famous geysers. There are numerous volcanic cones which are plainly visible from the railway.

After visiting Portland, Tacoma, and Seattle, we went by steamer up Puget Sound to Vancouver, in British Columbia.

The first station on the Canadian Pacific Railway that attracted our attention from a climatic standpoint was Kamloops, 250 miles east of Vancouver.

Kamloops is in a broad, open valley between the Gold and Coast ranges of mountains. The elevation is 1160 feet, and the air and soil are remarkably dry. The annual temperature is 46.3° F. The mean daily range in August and September is from 28° to 30° F. The annual rainfall is 11 inches. Kamloops has an exhilarating climate, and is favorable for the tuberculous during the warmer months. Dr. Proctor, of Kamloops, has reported favorable results in this class of cases, and a sanatorium for tuberculous patients might well be erected there. Kamloops is only 250 miles from Vancouver, but the climate is far more dry, and it is probably as desirable a site as can be found in this region.

Revelstoke is between Glacier and Kamloops, and has an altitude of 1475 feet. A beautiful side trip was made to Arrowhead, 28 miles distant by rail, and then by steamer down the beautiful Arrow Lakes, which stretch for 125 miles southward. The snow-capped mountains rise from the lake to heights of 6000 to 8000 feet. The elevation of these lakes, which are expansions of the Columbia River, is 1390 and 1380 feet. Some day these lakes will be widely sought as resorts. There are no accommodations at present, excepting at two mineral spring resorts, the Halcyon and St. Leon Springs, where patients are treated for rheumatism and metallic poison. The waters are hot, and contain large quantities of silica, sodium sulphate, and hydrogen sulphide. They deserve to be better known, and better facilities will no doubt be afforded in the future. These lakes remain open for navigation throughout the year.

After visiting Rossland, a famous mining town near

the American border, we returned to Revelstoke and proceeded to Glacier and climbed the Great Glacier of the Selkirks. This is only one of many in the region, and is the most accessible glacier on the continent. Swiss guides are available and necessary for expeditions on the ice.

Banff was visited, and for a prolonged visit affords the most varied opportunities for enjoyment, besides being equipped with hot sulphur baths that have valuable therapeutic qualities. The situation of the C. P. R. Hotel and the comforts provided were all that could be required.

Proceeding eastward past Calgary and the vast ranches of Alberta, we reached Winnipeg and passed quickly on through the Rainy Lake district to Lake Superior, thence to North Bay and by the Grand Trunk Railway to the Muskoka Lakes, where we inspected the Muskoka Sanatorium, with its fine new building for the free treatment of tuberculosis. This impressed us most favorably in its design, its equipment, its management, and in the cordial support accorded to it throughout Canada.

PRESIDENT'S ADDRESS.

SAMUEL A. FISK, A.M., M.D.
DENVER, COLORADO.

GENTLEMEN OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION,—It gives me unusual pleasure to greet you this morning and to say a few words about the aims of our Association and their fulfilment so far.

We style ourselves the *American* Association, claiming to ourselves a national character. It behoves us to see how far we deserve that title. I am glad to say that I think we comply with the requirement. Our membership includes men from the Lakes to the Gulf, and from one ocean to the other. In this respect we certainly are not local.

In our short existence as an Association we have met in many of the important centres of this country, including Boston, New York, Philadelphia and Baltimore. Five times, all the times there were, we have joined the other Associations in the Triennial at Washington, the capital of our country, and we have furnished a President to one of these meetings, two Presidents to the American Medical Association, and one to the Pan-American.

We have visited and seen for ourselves the hot springs of Virginia, the heights of the White Mountains, some of the resorts of New York and New Jersey, the wonders of Niagara, Denver, and the Continental Divide, and now we are holding

our meeting at the western limit of the country, on the border of the Pacific Ocean, and are endeavouring to inform ourselves in regard to the climatic features of California.

Our members are leaders in American thought and action too, in the lines that we advocate, and it does seem as though we vindicate our right to the term *American*. We aim to be national.

But our chief claim is that we are students of climate. Others are banded together to study correcting deformities of the skeleton, or the eye, or ear, or skin, or some particular part of the human anatomy, but our shibboleth is climate.

We do not aim to conflict with the admirable work of the Weather Bureau, but to supplement it. To aid and assist it. One of our chief members is a leading member of that Bureau, and we have been honoured by contributions from its Chief. Our members are some of the closest students of its *data*, they have been active in its support and extension, and in bringing it to the attention of the people; they have aided to establish State Weather Bureaus and to extend this means—and a valuable one it is too—of observation in certain somewhat limited areas.

Our TRANSACTIONS will show that our attention has been directed to the prevailing climatic characteristics of the several parts of our country. We have had presented to us researches on the ocean climate, the sea-shore, the climate of the interior, that of moderate elevation, and that of more marked heights. We know something of the effects of pure air, coupled with elevation and dryness, or of pure air wafted in by the sea-breeze, at ocean level, and as damp as that must make it.

But we are not students of climate from an indifferent, impersonal standpoint. It is our aim to apply to the individual the results of our study; to point out what would be beneficial or injurious. Man—the thinking, discriminating, animate being—has ever been our object of consideration.

Persons may accuse us of vacillation. The course pursued

may not always have been the shortest and most direct. The line may not have been undeviatingly straight. Sometimes we may not have seen the goal as clearly as we should. But we have pressed on. And who shall say that our face has not been in the right direction? With "climate" as our watch-word, and not without a certain amount of taunting, we have pushed on.

We have not advocated this or that drug, or this or that method. Our endowments have not been brick and mortar, nor hundreds, or thousands, or millions of gold and silver. We do not turn on the battery and see the nerves quiver; nor is our admiration directed only to the work of man's hand. It is our delight to talk of fresh air, to walk by the shore and hear the waves break; to forget for a while the strain; to take off our hats and let the mountain breezes blow through our locks; to remember that God made us human beings; to eat, to sleep, to breathe, to walk in the sunshine; to live and not to starve; to toss and twist under the burden of investments, to exist in the electric glare, and spend our days in a chase for gold, or in a vain endeavour to bolster ourselves up for this chase, or, like moles, to spend our time under ground. We bear in mind that certain functions are normal and necessary, however homely. Man was, man is, and is to be, and for him were these things made, and not he for them.

The Climatological Association bears this in mind. It endeavours to use the noble gift, common to all mankind, free as air; to use it aright itself and to show others how to use it. This gift of life is not limited to any one region, is not confined to any one spot. Man can live, and does live, north, east, south and west. One place has characteristics that another does not possess, and to which man must adapt himself, but wherever he lives and wherever he makes his home, Truth, the touchstone of science, is one and the same; she was there before man came—she will be there when man leaves and the Lord is Master. "Every day the sun, and, after sunset, night

and her stars. Ever the winds blow; ever the grass grows. Every day, men and women, conversing, beholding and beholding."

It is because we hold these views in common that we have come together into an "Association."

THE CLIMATE OF CENTRAL MASSACHUSETTS.

BY A. C. GETCHELL, M.D.
WORCESTER, MASS.

OF late serious and intelligent attempts have been made to apply the principles of climatic treatment to the sick in Massachusetts. These attempts have met with considerable success. The State has become interested in the work. By June of this year, nearly 300,000 dols. will have been expended upon an institution at Rutland, largely for the purpose of utilising the climate in the treatment of pulmonary tuberculosis. Since 1898 a large number of patients have been treated, the Sanatorium, which accommodates 175, being always full. And after July, 1902, it will be able to care for 250 at a time. Besides, there are large numbers of patients applying the same principles outside the institution. These considerations very well justify a study of the climate.

Climate is the condition of a place in relation to the various phenomena of the atmosphere, especially as they affect animal life or man. The chief factors determining the climate of a place are, (1) its latitude; (2) its elevation above the sea level; (3) the configuration of the land; (4) the character of the soil; (5) its relation to bodies of water; (6) the weather, *i.e.*, prevailing winds, amount of sunshine, humidity, &c. Upon these principles I have made my study.

Central Massachusetts is that part of the State which extends from a north and south line about forty miles west of Boston to the Connecticut River, and from New Hampshire on the

north to the State of Connecticut on the south. It lies between parallels 42° and 42° 45′ north latitude. This area has in its southern part a mean elevation of over 500 feet above sea-level, and in its central and northern part of 1,000 feet. It is called by geographers the central plateau of Massachusetts.

To get an intelligent idea of the configuration of the land and also of the soil, it will be necessary to briefly review the geological and geographical history.

We are told* that New England was once a mountainous district abounding in peaks of Alpine magnitude, with their accompanying glaciers. In the process of weathering, southern New England was worn down to nearly the sea-level. A few elevations are left, which show where the mountains were, conspicuous among these being Mt. Monadnock in Southern New Hampshire.

Throughout Massachusetts are elevations which are called from similarity in structure to their big brother, Monadnocks also. Among these are Mts. Wachusett, Watatic, Asnebumskit Hill in Paxton, and the Blue Hills of Milton.

The soil was much the same as it is to-day, formed under similar conditions, among the mountains of New Hampshire and Vermont.

After this wearing was accomplished, another agency gave quite a different character to the soil. The whole area became covered with glaciers, even the mountain tops being below their surface. These moved slowly toward the south and east, grinding down the hard peaks and scooping out the softer rocks into valleys. They carried along the soil they found ready made, plucked off pieces of ledge, and transported them sometimes rods, sometimes miles. The resultant of these agencies is a mixture of fine soil and rounded rock, varying in size from the pebbles in gravel, to enormous boulders. With few exceptions to be noted later, this is the soil of the plateau.

* "The Physical Geography of Worcester, Mass.," by Joseph H. Perry; "The Physical Geography of Southern New England," by Wm. M. Davis.

The lowest member of this drift, as it is called, is a compact mixture of all manner of materials, which lies directly on the scored rock. It is called boulder clay, till, or hardpan. This glacier deposit may be very thin, the underlying rock projecting through, or it may be heaped up into great mounds half a mile in length and 200 feet in height. These are called drumlins and are very common. Many may be seen on the upland between Spencer and Pomfret, Connecticut. They are common on the plateau and in the adjacent lower regions. In Worcester there is a row running the whole western side of the city, Mt Ararat, Bancroft Hill, Newton Hill, and Columbia Heights being among them. They are composed entirely of drift very compactly compressed. The tendency to cleavage sometimes seen in them shows that they have been subjected to an enormous pressure, that of the superincumbent glaciers. As a consequence of this, they are very impervious to water.

After the land had been worn down, smoothed off and moulded into different shapes, it was again raised to a considerable altitude. Then the wearing process was resumed with the result we see to-day. The Connecticut River, flowing through soft sandstone, wore for itself a broad valley leaving here and there an elevation like Mt. Tom and Mt. Holyoke rising out of the plain, because the material of which they are composed was harder than the surrounding sandstone. To the east of the Connecticut River the rock was harder than the sandstone, and hence the streams that came down from the higher land have carved their way through the ground, making numerous valleys with hills rising abruptly from them. As yet this process of wearing has not so greatly affected the internal high country. There is thus in the centre of the State a considerable area that preserves a uniform elevation above the sea, of about 1,000 feet. From any of the hills within this plateau, for such it is, one gets an even sky line in all directions, broken only by such isolated peaks as Wachusett and Monadnock.

On this plateau are North Brookfield, New Braintree,

Oakham, Paxton, Rutland, Princeton, Barre, Hubbardston, Westminster, Templeton, Phillipston, Petersham, Royalston, Winchendon, Gardner, and Ashburnham, all these towns and villages resting on the broad hills 1,000 feet or more above the sea.

To the west is a belt of towns somewhat back from the Connecticut River, in which belt the contour of the sky line is very uneven, suggesting mountains; yet the summits of these seeming mountains are at altitudes varying from 900 to 1,200 feet above sea level, no higher than the central plateau. The valleys are very numerous, some broad, and in them are nearly all the villages. In some of the northern towns of this belt, as Warwick, New Salem, Prescott, Pelham, the valleys as well as the hills are higher, but yet the mean elevation is below that of the plateau.

While, strictly speaking, the term plateau applies to the whole region, for convenience I shall restrict it to that portion having an altitude of 1,000 feet.

What is the soil of this section? Let us pass the several towns in review, beginning with Worcester. The city of Worcester lies in a valley, the bed of an ancient river. To the east is a high ridge or ledge covered more or less thickly with soil. Starting from the cut of the Boston and Maine Railroad near Boylston, it traverses the entire eastern boundary of the city terminating in Packachoag Hill in Auburn. It passes near the Worcester Insane Hospital, Worcester Academy, St. Vincent Hospital, and Holy Cross College. To the west rises the plateau attaining an elevation of 1,000 feet near the Tatnuck Country Club, before the Paxton line is reached. Below this elevation, as it were foothills, is a row of drumlins, now being rapidly covered by the spreading city.

Generally speaking, the soil of the elevated portions, whether it be the covering of the ledges or the drumlins, is glacier drift, and hence not porous. There are certain sections of the city, however, where the soil is gravel or sand, which may extend

to a great depth. These are the beds of old brooks. Thus a wide strip of sand extends under Union Street, past Front and through Green Street. Park Avenue represents the course of the bed of another brook, the soil being gravel. This soil extends along the Leicester Road beyond Gates Lane. To the south-east of this, beyond Hope Cemetery toward Auburn, is a series of sandhills. Beyond Gates Lane gravel soon disappears, and through Cherry Valley and Leicester to Spencer the soil is the heavy glacier drift. Ponds are frequent and springs very numerous.

In Spencer ledge is found, and I am told by a resident of the place that the cellars are damp. From Spencer the land drops suddenly and the soil changes. Through East Brookfield, Brookfield, West Brookfield, and Warren, there is a good deal of sand. To the north the land rises, and at North Brookfield the glacier drift again predominates. Between Spencer and Paxton I am told there is much sour land, a term which the farmers apply to stretches of soggy land.

In the village of Paxton water stands and cellars are not dry. Not a mile away, however, on the western shoulder of Asnebumskit the soil is very thin over the ledges. It is porous and water disappears with great rapidity after rains. From this point north to Rutland village, there is much sand, but it does not extend to the village itself, the soil there being again drift.

The soil on which the Sanatorium is built is a clay gravel, very dense and impervious. Except where, from the inclination of the land, the water may run away, it disappears slowly from the surface of the ground.

In the valley at Coldbrook, north-west from Rutland, are numerous sand-banks, but as one ascends the hills to Barre, the denser soil again predominates and continues through Petersham to Athol. The old road from Barre to Petersham, nearer Hubbardston, goes through a much more sandy district.

From Athol east by the trolley to Gardner, through Phillipston, ledges are more frequent and glacier boulders are very

numerous. Clearings are not many and farms appear to be poor. At Templeton, however, the aspect of the country is different. The tilled fields are broad and apparently fertile; but the number of stone walls shows the universal presence of the drift. Here again sand appears, and one passes patches of it along the road until Gardner is reached. These sandhills are borders of a large tract of deep and fine sand that extends through Royalston into New Hampshire, embracing also portions of Winchendon and Gardner. In Gardner there are many drumlins, indeed the town is mostly built on them. One would therefore suppose that the soil does not part readily with its water, and I am told that the cellars are generally not dry.

Ashburnham I have not been able to visit, but I am told the soil is much the same as it is in Fitchburg, which is built on high out-cropping ledges, small mountains, in fact. And one can see it is so, for in Ashburnham is Watatic, the northernmost Monadnock in Massachusetts, and one of the most important of that brotherhood.

Now in Fitchburg, a householder tells me that the cellars where uncemented are wet, the water percolating through the ledges. Through Westminster extends the chain of ledges, culminating in Wachusett.

The soil in Princeton is glacier drift as elsewhere. Some of the Princeton people think it is very dry, and that water disappears quickly after rains. Most of the summer residences are on the mountain side, where the soil may be thin, or in such situation that water disappears rapidly by surface drainage. In the valley to the east, through East Princeton and Quinepoxet to Holden, there is much sand.

In Hubbardston, a few miles to the west, a patient tells me that water is frequently found in his cellar and that pools remain long in the road. In spite of this he and his family are much benefited by a residence there, particularly in finding relief from coughs and colds.

What is true of Hubbardston is also true of other places.

They are all on hills so that the natural drainage is good, and while the soil is generally not porous, the water runs away and even if it does not naturally, it can be made to very easily. At all events the pure air largely offsets this disadvantage of soil.

From this brief review one sees that the soil of the hills is generally dense and that of the valleys porous. The valleys represent the courses of old rivers, and the sand is the deposit of them. A good illustration of this is the Nashua River, the representative of a much greater predecessor.

The excavations now going on for the great Metropolitan Storage basin show much sand and gravel. Further down its course in Lancaster the river runs through broad valleys of gravel, and still further on, in Shirley, Ayer, and Groton, are wide fields of sand.

Again we find small areas of sand and gravel where there is no existing river nor evidence of a pre-existing one. These were deposited by the melting glaciers. Illustrations of such deposits may be seen on the west shore of Lake Quinsigamond and the sandhills at Jefferson appear to owe their origin to a similar cause.

Much of the land is wooded. Possibly there are more trees growing than there were fifty years ago. One frequently comes across stone walls in the woods, the boundaries of once tilled fields. The prevailing trees are maple, chestnut, hickory, oak, elm, ash, birch, white birch, fewer yellow birch, poplar, hemlock, and pine. Pine does not grow in large numbers over considerable areas, but one cannot go in any direction without seeing some. I can recall but one place where the trees seem not to be second growth. The stage road from Petersham to Barre runs through a beautiful forest of large, mature trees.

While gathering material for this paper I have often been impressed with the advantages that Templeton offers as a residence for consumptives. It is situated on high land, commanding a wide prospect. To the west is an unimpeded view to Greylock mountain and to the north to Monadnock. The soil

is sandy. I have before mentioned the fact that it is on the southern border of the large sand belt stretching to New Hampshire. Dr. Greenwood, a practising physician there, confirms my idea of the place. He says in a letter answering an inquiry, "The soil is generally sandy and much of it unfit for farming purposes. Cellars are generally dry and we recover from thunder showers with commendable promptness."

It is a farming community. The Fitchburg railroad is five or six miles away, and what factories there are in the neighbourhood are some distance away. I think they are run by water power. Indeed, they have no effect on the purity of the air. Through the village runs a trolley line from Gardner to Athol, bringing it within easy reach of Boston. It has an excellent hotel, built and equipped by a "son of the place," open summers.

Discussing the weather of this section, I shall describe in particular detail that of Worcester, because I am most familiar with it, and also because there is here a station of the United States Weather Bureau, from the custodian of which, Mr. George W. Swan, I have obtained the statistics which will be presented later.

Worcester is spread over land varying from 500 to 1,000 feet above the sea level. It is about equi-distant from Boston and Providence, being forty-four miles from each place, and from Long Island Sound at New London, it is distant seventy-two miles.

The climate is more inland than sea-board. It is out of the range of the diurnal variation of wind, which is characteristic of shore localities. In the winter we do not have the very damp and trying east winds of Boston.

The weather differs quite perceptibly between one part of Central Massachusetts and another. Thus it is a matter of common observation that the towns south of us have warmer weather than we do. This is seen especially in winter when slight variations of temperature will make the difference between

rain and snow. We have more sleighing in Worcester than they do in Webster and Uxbridge, and not infrequently a snowstorm here will be rain there. The warmer weather of these towns is attributed to their nearness to the Long Island Sound.

Climatological Summary.

Worcester, Mass.

Averages for Ten Years—1892-1901.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Temp.		24·8	24·3	33·9	45·9	57·5	67·2	71·4	69·2	61.7	50·9	39·2	29·5
No. of Days	Clear	10·0	8·9	9·6	10·3	10·6	9·8	10·5	12·3	13·2	11·6	8·0	10·5
	Partly Cloudy	11·1	10·1	10·3	8·7	10·3	11·1	13·5	11·5	9·5	10·6	10·4	11·0
	Cloudy	9·9	9·1	11·1	11·0	10·1	9·1	7·0	7·2	7·3	8·8	11·6	9·5
	Rainy	9·9	8·9	12·7	10·4	11·7	9·2	11·5	10·4	8·8	7·0	11·6	9·4
Total Precipitation		2·86	4·18	4·46	3·16	4·21	2·84	4·06	3·41	3·10	3·48	4·98	3·62
Prevailing Wind		N.W.	W.	W.	N.W.	W.	S.W.	S.W.	S.W.	S.W.	W.	N.W.	W.

Mean Annual Temperature	47·9
Number of Clear Days	115·3
Number of Partly Cloudy Days	128·1
Number of Cloudy Days	111·7
Number of Rainy Days	121·5
Total Annual Precipitation in inches ..	44·36
Prevailing Direction of the Wind	Westerly

Mean Dry Bulb Temperature.

Mean Wet Bulb or Sensible Temperature.

Total Precipitation in Inches.

Worcester, Mass.—1901.

	January	February	March	April	May	June	July	August	September	October	November	December
Mean Dry Bulb Temperature	25·0	20·4	34·0	45·5	56·3	68·8	74·3	71·3	64·5	52·6	34·8	29·4
Mean with Bulb or Sensible Temperature		17·2	30·7	41·8	50·2	60·3	66·8	64·7	57·9	46·0	31·1	26·8
Total Precipitation in inches	1·49	0·67	5·33	6·81	5·53	0·93	4·30	3·34	2·14	3·35	2 15	7·41

The average of fourteen days' temperature taken about 8 a.m. in February, 1902, in Worcester, was 16·2; for the Webster observations 18·7. These observations show that when the temperature is about 10° above zero, it is the same in each place, but when it is higher, it is much higher in Webster.

On the other hand, the United States Weather Bureau reports for January, February, and March, 1902, show that the mean temperature of Groton is 1° lower than Worcester. Now Groton is nearly due north from Worcester about thirty-two miles, but lower by 200 feet.

On the other hand, as one ascends the plateau from Worcester, one finds numerous evidences of a different average of temperature. Paxton lies to the west slightly to the north seven miles away; Rutland a little farther to the north and twelve miles away. The slope of the Paxton hills is plainly seen from many places in the city, and in spring and fall the terminus of the snow line is easily noted. Moreover, in the spring the trees bud out in Worcester nearly two weeks earlier than they do in Rutland.

In January of this year a well-equipped weather observatory was installed at the Sanatorium at Rutland, and we have reliable data from February. From these I have compiled some statistics.

Mean Monthly Temperature of Worcester and Rutland in Degrees Fahrenheit.—1902.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
W.	24·2	26	41·9	47·5	57·6	64·4	67·2	67·6				
R.		22·34	37·87	45·40	54·4	60·5	64·4	64·8				

Greatest Daily Range of Temperature in Degrees Fahrenheit. Worcester.—1901.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
29	27	20	36	34	31	28	28	29	29	23	34

Mean annual daily range—29.

WORCESTER AND RUTLAND.—1902.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov	Dec.
W.	27	24	28	44	34	32	30	27				
R.		32	22	44	34	31	30	30				

HIGHEST AND LOWEST TEMPERATURE BY MONTHS.

WORCESTER.—1901.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Highest	47	43	54	84	85	96	97	87	90	75	62	63
Lowest	—8	6	4	32	37	47	51	57	40	31	8	5

Highest Temperature 97 on July 2.
Lowest Temperature 8 on January 20.

Monthly Mean { Highest 73·58. Lowest 25·83.

HIGHEST AND LOWEST TEMPERATURE BY MONTHS.
WORCESTER AND RUTLAND.—1902.

WORCESTER.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Highest	49	56	68	87	88	90	90	88				
Lowest	2	7	19	30	31	47	50	50				

RUTLAND.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Highest	—	57	65	81	85	86	86	83				
Lowest	—	5	17	27	26	40	49	44				

NUMBER OF RAINY DAYS AND CHARACTER OF SKY.
WORCESTER AND RUTLAND.—1902.

	Number of Days.							
	Rainy.		Clear.		Partly Cloudy.		Cloudy.	
	W.	R.	W.	R.	W.	R.	W.	R.
January	9	...	13	...	7	...	11	...
February	9	11	13	10	7	6	8	12
March	13	17	12	8	9	12	10	11
April	8	7	7	8	13	12	9	12
May	10	5	14	11	10	14	7	6
June	15	8	12	11	10	12	8	7
July	14	11	6	8	12	7	13	16
August	6	8	9	16	15	7	7	8
September ...								
October								
November ...								
December ...								

To obtain an idea of the character of the weather of this section as compared with that of other parts of the State, I have compiled the following statistics. Out of twenty-one observation stations, mostly east of the Connecticut River, Worcester ranks fifth in the number of rainy days.

CHARACTER OF THE SKY.

SUMMARY FOR 1901.

	Number of Days.			
	Rainy.	Clear.	Partly Cloudy.	Cloudy.
Nantucket	145	83	101	181
Middleboro	138	164	109	90
Concord...	133	108	102	155
Williamstown	133	106	66	192
Worcester	131	124	122	119
Boston	125	128	97	140
Pittsfield	77	233	27	105
Monson	63	106	24	84

The relative humidity and total movement of the wind is not given for Worcester, and I have selected the statistics of the station nearest the plateau and compared them with Boston.

MEAN RELATIVE HUMIDITY.

1901.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean.
Boston	72	61	70	60	77	68	75	78	79	77	75	77	72·42
Amherst	74	68	71	68	68	66	72	76	77	70	71	70	70·91

1902.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Boston	73	76	74	71	66	69	75	74				
Amherst	66	69	72	67	63	71	77	70				
Rutland	—	70	74	67	66	74	82	76				

TOTAL MOVEMENT OF THE WIND IN MILES.—1902.

	Jan.	Feb.	March	April	May	June	July	Aug.
Amherst ...	4·078	5·199	6·601	4·642	4·328	4·102	2·929	2·380
Blue Hill	15·489	16·674	15·985	13·238	12·988	12·420	10·407	10·297
Boston ...	8·932	9·832	9·794	8·644	8·368	7·978	6 544	6·251
Concord ...	5·429	6·781	7·110	5·648	—	4·079	3·227	2·820
Nantucket	11·462	12·895	12·911	16·596	10·446	10·110	8·315	7·407
Rutland ...	—	9·642	9·286	8·781	7·680	7·462	6·219	5·441

The influence of the higher level of land upon the quality of the air is very decided. The area of the plateau is about 700 square miles. It is more than forty miles from the ocean, contains no large bodies of water or marshy lands, and few large towns. The nearest large manufacturing city is Worcester, to the south-east. Whatever deleterious influence that might exert is counteracted by the prevailing direction of the wind. With the exception of Gardner and Winchendon very little manufacturing is done. There are a few saw-mills and furniture factories which are mostly run by water power. Excepting the Fitchburg railroad, which runs through the northern part, there is comparatively little railroad traffic and smoke from engines. The land is either grown up to woods or is under cultivation, so that the highest winds are not dusty.

All of the towns are built either on a rise of land or are near one, so that there is always a free circulation of air, and as there is no source of contamination, it is pure. Some of the towns command a very extensive sweep of country. From Rutland, Petersham, and Templeton on clear days, Greylock in the Berkshires, sixty miles away, can be plainly seen as well as Monadnock in New Hampshire and Wachusett nearer by.

Clouds at Rutland.—Although, as a general rule, the air is clearer on the plateau than at lower levels, at Rutland, at least, the reverse is sometimes the case. In September, 1900, there were several days of continuous fog. Those who had occasion to go from the Sanatorium during that time noted that they emerged from the cloud on the way down and entered it returning. In a general way, by inquiry, I have confirmed this observation, and twice this spring have done so myself by a personal observation. March 16, in the morning, the sky at Worcester was overcast and threatening rain. At noon, being on the hills to the east of the city, I remarked that while the valley was clear of mist, clouds appeared to rest on the hills beyond. On inquiry, I found that the Sanatorium was in fog the whole morning. April 9 I had occasion to go to Rutland

in the afternoon. This was in the midst of a long storm, although during this afternoon there was no rain. In Worcester and at Oakdale the air was clear, though the sky was overcast. At Jefferson the mist was general, and on the hill at the Sanatorium it was so dense that the buildings could not be made out until we were very near them. It was like driving up a mountain summit in a cloud. In November, 1900, a severe ice storm destroyed many trees in Rutland and also, I am told, in Templeton. Two miles down the hill in Jefferson, there was no ice, only rain, during this storm.

Evidently Rutland lies high enough to be in the zone of the atmosphere where may be low lying clouds. True fogs, on the other hand, that is, condensation of moisture because of contact with the earth, are uncommon.

The agreeable character of the summer climate of the plateau is indicated and emphasised by the fact that the towns are much frequented by visitors. Princeton has several excellent hotels and many summer residences, as also does Petersham. In Rutland are two good hotels, and recently an excellent one has been built for summer business in Templeton. Barre, a larger place than her neighbours, has good hotels and summer visitors; while many Worcester business men have summer homes at Westminster and Hubbardston. Just on the border of the plateau, Leicester and Sterling are popular places of resort. Most of these places are two or three miles from railroad and must be reached by stage; some are further. The nearest railroad to Petersham is at Athol, seven miles away, while Paxton is nine miles from Worcester. Sterling is on a railroad. Leicester and Templeton are reached by trolley.

Making allowance for the local differences, the climate of this entire section is much the same.

Winter, meaning by that the advent of snow and freezing, begins in the latter part of November, but it is exceptional to get much snow or ice before Christmas. If the ponds are frozen early in the season and to any thickness, they are rarely

free of ice until spring. Not so the snow. However cold the weather may be, and however much the snow-fall may be, three weeks rarely pass without a warm rain, and unless there be much snow it all disappears. Six weeks' consecutive sleighing is a long time for Worcester.

The lowest average of temperature for any month, as will be seen by the tables given later, is for the month of February, although it will be found by examination of the records of the different years, that the lowest monthly average for some years is in January. The old saying, therefore, "When the days begin to lengthen the cold begins to strengthen," has a basis in fact. February is slightly colder than any other month, but much more disagreeable because of the high winds. While the temperature rises in March, the high winds continue and these, added to the increased dampness, makes this month the most trying of the year to invalids. Little more can be said for April. The month with us bears out its reputation of fickleness. There may be a few days of most delightful warmth and sunshine, only to be followed by storm and even snow. The first of May marks the end of the furnace fire, but if allowed to go out there will surely be shivery homes in the next two weeks. During this time health seekers should be cautioned against returning to the north from the already heated south.

Indeed, we can hardly be said to have a spring. It is the end of winter, then summer. Lowell puts it well, when he says—

> "Jes' so our spring gits everythin' in tune,
> An' gives one leap from Aperl into June."

As a whole the summers are agreeable. The temperature varies as elsewhere in this latitude. A spell of extreme heat is but of a few days' duration. In Worcester sunstrokes are not at all common, and occur only among labourers working in trenches exposed to the direct rays of the sun. The nights are generally comfortable. The city is so hilly that many—most, one could say—of the dwelling houses are on hills, a

situation which affords good breeze. It is exceptional even in the centre of the city for the nights to be so oppressive that some bed cover is not needed.

Trolleys take one quickly to the hills immediately about, and a half hour's ride will reach Leicester, nearly 1,000 feet above the sea, where one finds a decided change of air, even on the hottest days.

In the first week of September there may be a few intensely hot days, which are particularly trying to those just returning from a sojourn in the mountains, or at the sea-shore; but the month generally is pleasant. The average for ten years shows that in this month are more clear days than in any other month. By the last of the month the evenings may be chilly enough to make an open fire cosy. On the first of October your methodical housekeeper starts his furnace fire, but for two weeks it is apt to be a burden. The month has many pleasant days, tempting to out-of-doors life more than those of any other month, and these days extend far into November.

Like the climate of all of New England, that of this section is subject to sudden and extreme changes. But that question was thoroughly discussed by Dr. Hinsdale at our last meeting, and I need not dwell upon it.

Such is the climate of Central Massachusetts. Not one to attract health seekers; indeed, such a one that needs New England thrift to extract any considerable amount of good from it. The task we have is to show a profitable use of Nature's begrudging gifts.

Mean Temperature.
Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	17·7	27·2	25·0	23·2	26·3	25·7	26·4	26·8	25·0
February ...	—	23·6	21·2	20·9	25·9	28·4	29·9	22·2	26·1	20·4
March	—	31·6	40·9	32·6	29·3	35·0	42·0	28·9	31·0	34·0
April	47·7	42·9	46·3	45·6	48·0	46·5	42·8	47·2	46·6	45·5
May	55·9	55·6	57·4	59·1	61·8	57·8	—	59·2	54·6	56·3
June	70·4	65·4	67·5	68·5	64·6	62·4	—	69·6	67·2	68·8
July	72·5	69·1	72·6	67·9	71·0	71·8	—	—	71·8	74·3
August	69·8	68·7	67·0	69·5	69·6	67·7	—	—	70·0	71·3
September ...	62·0	57·0	63·5	63·6	59·9	61·0	—	60·1	64·1	64·5
October	51·0	52·5	51·9	46·2	48·1	52·1	—	52·9	—	52·6
November ...	39·3	38·5	—	42·4	44·8	38·8	35·5	39·3	—	34·8
December ...	27·3	26·9	—	33·1	27·5	31·4	27·7	32·6	30·1	29·4

Total Precipitation in Inches.
Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	2.68	2·98	2·12	1·93	3·26	4·28	3·83	3·13	1·49
February ...	—	6·91	2·84	1·14	5·69	2·95	4·78	5·25	7·45	0·67
March	—	3·90	1·31	2·67	6·91	4·09	2·37	7·29	6·27	5·33
April	0·60	3·56	3·60	4·27	1·23	2·65	4·19	2·13	2·56	6·81
May	6·34	6·95	4·63	2·46	2·78	4·52	—	1·25	3·47	5·53
June	2·22	2·54	0·73	3·44	3·75	4·13	—	3·89	3·98	0·93
July	4·70	1·38	3·75	4·10	3·55	7·25	—	—	3·49	4·30
August	5·51	3·27	1·47	5·19	2·56	3·21	—	—	2·76	3·34
September ...	1·74	1·98	3·16	2·39	7·45	1·85	—	4·20	2·21	2·94
October	0·58	4·68	3·96	8·02	4·90	1·05	—	1·34	—	3·35
November ...	5·82	2·28	—	8·69	3·02	6·92	8·36	2·60	—	2·15
December ...	1·00	4·65	—	4·03	2·25	6·04	3·04	1·69	2·50	7·41

Number of Rainy Days.
Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	10	11	10	11	7	9	7	11	13
February ...	—	15	10	5	7	6	10	14	10	3
March	—	11	8	15	17	12	11	16	9	15
April	6	13	12	12	6	11	14	5	9	16
May	17	14	11	10	10	12	—	7	9	16
June	13	10	5	12	10	13	—	9	7	4
July	11	9	11	12	13	11	—	—	11	14
August	10	13	5	8	12	11	—	—	13	11
September ...	5	8	10	7	13	6	—	10	7	13
October	6	6	9	6	14	3	—	6	—	6
November ...	15	8	—	15	9	18	13	8	—	7
December ...	8	14	—	8	6	14	6	8	8	13

Number of Clear Days.

Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	10	9	8	11	9	11	16	7	9
February ...	—	8	5	9	10	10	11	8	8	11
March	—	10	6	11	9	12	11	11	12	4
April	10	5	10	8	12	14	8	20	11	5
May	7	7	10	11	10	10	—	22	9	9
June	6	7	5	10	9	10	—	14	13	14
July	16	4	13	12	11	7	—	—	9	12
August	15	11	14	14	13	14	—	—	8	8
September ...	16	10	11	14	10	17	—	13	10	18
October	11	9	11	13	10	19	—	7	—	13
November ...	8	5	—	8	5	8	13	8	—	9
December ...	11	7	—	11	16	9	12	9	9	11

Number of Partly Cloudy Days.

Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	10	11	10	12	14	9	4	17	13
February ...	—	8	11	12	10	10	6	10	9	15
March	—	12	17	8	11	7	9	5	12	12
April	10	10	8	9	14	8	8	6	9	5
May	9	10	10	12	16	10	—	4	13	9
June	14	8	13	10	14	10	—	11	9	11
July...	7	23	14	11	12	16	—	—	17	8
August	5	8	9	13	14	13	—	—	18	12
September ...	9	9	12	11	10	8	—	10	13	3
October	14	13	9	11	6	7	—	11	—	14
November ...	9	18	—	8	11	12	3	12	—	10
December ...	13	10	—	10	11	11	8	14	12	10

Number of Cloudy Days.

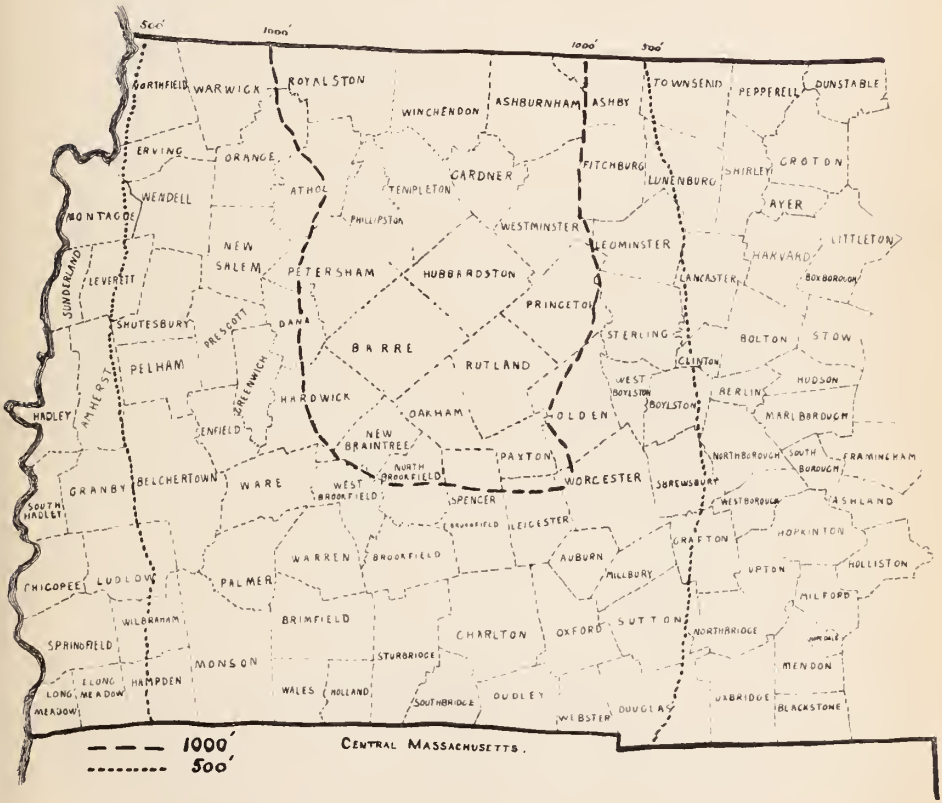
Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	11	11	10	11	7	9	7	11	13
February ...	—	12	12	5	7	6	10	14	10	3
March	—	9	8	15	17	12	11	16	9	15
April	10	15	12	12	6	11	14	5	9	16
May	15	14	11	10	10	12	—	7	9	16
June	10	15	12	12	10	13	—	9	7	4
July...	8	4	4	12	13	11	—	—	11	14
August	11	12	8	8	12	11	—	·	13	11
September ...	5	11	7	7	13	6	—	10	7	13
October	6	9	11	6	14	3	—	6	—	6
November ...	13	7	—	15	17	18	13	8	—	7
December ...	7	14	—	8	6	14	6	8	8	13

Prevailing Wind.

Worcester, Mass.

	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	—	N.W.	N.W.	N.W.	N.E.	W.	N.W.	N.W.	S.W.	N.W.
February ...	—	W.	W.	W.	W.	W.	N.W.	N.W.	W.	N.W.
March	—	W.	W.	N.W.	W.	N.W.	S.W.	N.E.	N.W.	N.W.
April	N.W.	N.W.	N.W.	N.E.	N.E.	S.W.	N.E.	N.W.	N.W.	N.E.
May	S.W.	W.	N.W.	S.W.	W.	W.	—	S.W.	W.	N.E.
June	S.W.	N.E.	W.	N.E.	W.	S.W.	—	N.W.	S.W.	S.W.
July...	S.W.	W.	S.W.	S.W.	S.W.	S.W.	—	—	S.W.	S.W.
August	S.W.	S.W.	S.W.	W.	N.W.	S.W.	—	—	S.W.	S.W.
September ...	S.W.	W.	W.	W.	S.W.	W.	—	S.W.	S.W.	S.W.
October	W.	W.	N.	W.	N.E.	W.	—	N.E.	—	S.W.
November ...	N.W.	W.	—	W.	N.W.	N.W.	N.E.	N.W.	—	N.W.
December ...	W.	W.	—	S.W.	N.W.	W.	W.	S.W.	S.W.	W



DISCUSSION.

Dr. OTIS: I think that as a corollary to this excellent paper of Dr. Getchell's, some mention should be made of the application of this climate to the treatment of tuberculous patients. I am sure that some of the gentlemen out here would like to know something of the results of such treatment, and I trust that Dr. Bowditch will speak of his experience at Rutland, Mass., where, as you know, the State Sanatorium is situated. Only the incipient cases, or so regarded hopeful cases, are received at the State Sanatorium, but from Rutland's initiative there have sprung up in that region many small boarding houses which have been presided over generally by graduates of the Sanatorium; and here are received considerable numbers of the more unfavourable cases which are refused at the State Sanatorium. I have had charge for several years of a clinic at Boston where large numbers of patients in the various stages of tuberculosis appear, and I have been able to make use of these boarding houses, which are very moderate in price, and have been surprised and pleased at the results. The economic cures, if I may speak of them in such a way, have been most satisfactory. Many of these houses charge only from 5 dols. to 7 dols. per week, but have a *régime* that is very exacting. The officers presiding over them are imbued with the advantages of out-door life and proper care. I had a young lady in one of these boarding houses a few months ago, who, during the whole of the inclement winter weather, was out-doors eight hours daily. There was no fire in the house except in the very cold weather, she was obliged to sleep with open windows; every morning she took a cold bath, and, from a condition of hopelessness she has improved so as to be able to support herself. One query occurs to me upon which I would like to ask Dr. Getchell's opinion. The question is, will evaporation from the large body of water which will be accumulated in the vicinity of this region when the huge Metropolitan bath basin now in construction, is completed, have any effect upon the humidity of this region? I myself should think not.

Dr. BOWDITCH: I wish to express my appreciation of this admirable paper, because such work goes hand in hand with the clinical work we are now doing in Rutland and Sharon. I cannot go into detail here, of course, but I will say that in our last Annual Report at Rutland we published the results of our work. It shows that in the cases that have been arrested (some of them being what is sometimes called "apparently cured") we had a percentage of 42 +. I am speaking now of my own service, and these statistics are from *all* the cases that have entered, and are not confined to the so-called "incipient" cases. Our cases are chosen and picked, of course, but are not always incipient. The average length of duration of the disease before patients enter the Sanatorium is ten months, which should convince you that they are by no means all incipient cases. In the small Sanatorium at Sharon, the results during the last two years have been even more gratifying (the percentage of arrested cases being 54 +). Whether this arises from the fact that we have there a smaller

number of cases and can therefore give greater individual care, and can select our cases more closely than at Rutland, I cannot say. I wish again to express my appreciation of Dr. Getchell's work, as one of my co-workers, I may say, and one of our most valuable trustees at the Rutland Sanatorium.

Dr. HINSDALE: I would like to add a word of appreciation of Dr. Getchell's work in this part of Massachusetts. I am familiar with the country a little to the west of Rutland, and I recognised all through his paper the conditions described. The country is well wooded between Rutland and the Connecticut river, especially up to within five miles of the river, and it is a healthful, comparatively dry region, many of the places well suited to the establishment of such Sanatoria as that now existing at Rutland. One of the most salubrious places there is the town of Pelham, on the border of the western plateau, amid beautiful surroundings, and with numerous mineral springs that will probably be more largely utilised than at present. There is also a great deal to interest the visitor, for there are numerous trout streams—I have fished many of them—and it is a great thing to be able to locate some patients, particularly young men, where they can have sport, hunting, fishing, &c. I am sure these features of the western slope of that hillside affords all sorts of opportunities for health and pleasure. These matters are very important, as they give content to the mind and prevent home-sickness and distress of mind arising from lack of interest in one's physical surroundings. We have been through territory on this trip where no birds are seen, no fish are to be caught; and the influences of desolation on the human mind, although the sky may be bright and the air dry, should be taken into consideration in choosing a health resort.

Dr. FISK: I simply want to say that in the last few years I have spent considerable time myself on the hills of this country described. I had some patients up there and can attest to their doing very well. It is a delightful country, about 1,000 feet high, cool in summer, but the winds blowing in winter so that you can hardly keep your feet. I have had patients start in these for the summer months and then later on go out to the western country, especially Colorado.

Dr. GETCHELL: I will simply speak on the point Dr. Otis alluded to. The Metropolitan area, Boston and the adjoining towns, have come up here and are building a large dam on the river that will cause a flow back to cover an area about nine miles in length, and averaging two miles in width, to make a great lake. I cannot see how it is going to materially affect our atmosphere as concerns moisture. The climate in this respect approaches nearly that of Boston, a city as you know, which is nearly surrounded by water, and it would seem that this added volume of water in our neighbourhood could not appreciably affect the climate.

THE RELATION OF SUNSHINE TO THE PREVALENCE OF INFLUENZA.*

Meteorological Study No. 2.

BY HOWARD S. ANDERS, A.M., M.D.
PHILADELPHIA.

THINKING that there might be more elements and influences in the air and soil than were ever detected and demonstrated in connection with our etiology of influenza, I began, two years ago, a special and methodical study of the meteorological conditions just antecedent to, as well as associated with epidemics of this disease since 1895. The outcome was a preliminary paper ("The Relation of Local Meteorologic Conditions to the Influenza Epidemic in Philadelphia, Winter of 1898-99") read before this Association and based upon a comparative analysis of the data for four years, for the months of October, November, December and January, the grip epidemic of 1898-99 having been at its height during the two months last named.

Introductory to the present observations it may be quite relevant to repeat here the tentative conclusions then reached, which were as follows: (1) Abnormal increase in the barometric pressure, and in the absolute range between the highest and lowest pressures for the epidemic months; (2) sudden, frequent and extreme alternations of abnormally high and low temperature ranges; (3) comparatively lower relative humidity during the prevalence of sharply epidemic influenza; (4) diminished

* Read before the American Climatological Association, Niagara Falls, N.Y., June 1, 1901.

precipitation, but short periods of unusual fogginess alternating with periods of dryness; (5) marked prevalence of strong northerly winds frequently alternating with very calm weather; (6) predominance of relatively clear and sunshiny days during exacerbations of influenzal attack; these attacking periods having invariably been preceded by sudden thaws and relatively warm, damp, muggy weather.

TABLE I.—AVERAGE HOURS AND PER CENT. OF SUNSHINE.

	Jan.		Feb.		March.		April.		Nov.		Dec.	
	Aver. hours.	Per cent.	Aver. hours.	Per cent.	Aver. hours.	Per cent.	Aver. hours.	Per cent.	Aver. hours.	Per cent.	Aver. hours.	Per cent.
1891	4·1	44	3·7	34	3·7	31	7·3	54	4·8	48	4·7	49
1892	3·6	37	3·5	33	5·5	47	5·8	44	4·2	42	4·0	42
1893	4·4	45	4·3	39	5·5	46	5·0	38	4·9	49	4·3	46
1894	4·7	48	5·8	54	8·1	67	8·2	62	5·7	57	5·3	56
1895	5·2	54	7·0	66	6·9	57	7·7	58	5·2	52	5·3	56
1896	5·6	57	6·0	56	7·6	64	9·4	71	5·3	53	6·6	70
1897	5·2	54	6·2	58	7·1	59	9·5	72	4·7	47	4·6	49
1898	3·9	40	6·9	65	5·4	45	7·1	48	5·2	52	5·1	54
1899	5·2	54	5·4	50	5·0	41	10·4	78	6·5	65	6·9	73
1900	5·9	61	5·2	53	6·8	57	8·1	61	5·1	51	5·7	61
1901	5·5	56	8·0	74	5·4	45	4·8	36				
Total average per cent. ...		50		53		51		56·5		51·7		55.6

It was and is my purpose to complete these partial investigations and analyses by separate and seriatim studies of each meteorologic phenomenon and its relation to epidemic influenza; and to consider each phenomenon over a greater number of years, so as to afford a more reliable basis for more definite and decisive conclusions.

It is quite true, as Crawford† intimates, that practically nothing is known concerning the external conditions—meteorologic and telluric—that presumably favour the propagation of epidemics of influenza more violently and generally at one time than at another. The hope is cherished that in this series of

† *Jour. Amer. Med. Assoc.*, January 27, 1900, p. 200.

researches something may be learned that may have somewhat of the prophylactic value to the public health that a storm signal has to those who sail in ships and cultivate our crops; or that a local weather forecast has to those who wish to go out of doors properly and prudently clad.

TABLE II.

	Hours of Possible Sunshine.	Hours of Daily Average Possible.
January	301·1 ÷ 31 =	9·7
February	299·7 ÷ 28 =	10·7
March	371·2 ÷ 31 =	12·0
April	398·6 ÷ 30 =	13·3
November	299·7 ÷ 30 =	10·0
December	291·7 ÷ 31 =	9·4

The relation between sunshine and the prevalence of influenza is studied first simply because suggested at this time by some observations made by J. Ruhemann, of Berlin.‡ It appeared that influenza was more prevalent when the amount of sunshine was less. In the eight years from 1893 to 1900 the number of hours of sunshine in Berlin during the month of January, when influenza was most prevalent, was between 9·8 in 1900 and 62·3 in 1899; the mean being 36·4 hours. Similarly, in Madgeburg from 1882 to 1900 the number of hours of sunshine varied during the same month between 19 in 1900 and 86·3 in 1883. A dozen other German cities and towns showed similar figures. More value might, however, be attached to these manifestly suggestive figures if they had been studied in relation to the mildness or severity of annual grip epidemics; if, as in the case of the Magdeburg observations, preceding years had also been noted for Berlin, before the 1889-90 pandemic; and if other influenzal months had been compared.

‡ *Berliner klin. Woch.*, February 26, 1900, No. 9, p. 199.

As before, so now, through the kind courtesy of Mr. L. M Dey, local forecast official in Philadelphia for the United States Weather Bureau, the accompanying tabulated data were readily obtained. The figures were taken for the six months—November to April inclusive—when influenza has been most prevalent.

TABLE III.—CLEAR DAYS.

	Jan.	Feb.	March	April		Nov.	Dec.
1880	4	10	6	14	1880...	9	10
1881	5	8	6	8	1881...	12	11
1882	5	12	7	6	1882...	8	5
1883	3	4	11	7	1883...	16	7
1884	6	3	6	7	1884...	12	5
1885	7	8	6	10	1885...	5	8
1886	8	11	8	5	1886...	14	9
1887	8	6	7	8	1887...	10	6
1888	6	6	9	14	1888...	9	14
1889	13	3	11	6			
					Totals	95	75
Totals ...	65	71	77	85			
					1889...	7	11
1890	7	7	4	10	1890...	10	9
1891	11	8	7	15	1891...	11	15
1892	10	8	11	9	1892...	9	6
1893	10	6	8	6	1893...	8	8
1894	9	5	12	13	1894...	14	10
1895	8	10	13	11	1895...	11	10
1896	10	10	14	9	1896...	9	11
1897	11	6	8	14	1897...	5	5
1898	5	12	6	6			
1899	10	11	4	13	Totals	84	85
Totals ...	91	83	87	106			
					1898...	8	10
					1899...	14	7
1900	10	8	7	9	1900...	7	11
1901	8	4	8	1			

Tables I. and II. should be considered together, for the obvious reason that the average hours of sunshine, as recorded for the epidemic months, should be compared with the daily average hours of sunshine possible for the respective months,

so that the percentage of sunshine (Table I., 2nd column) may be derived. It is unfortunate for the most satisfactory comparative study that the exact instrumental registry of sunshine was not begun before January 1, 1891, in Philadelphia, thus omitting the important pandemic months of 1889-90, as well as preceding normal or merely sporadic years. The other tables, though less mathematically precise in construction, nevertheless compensate somewhat for this shortcoming in their more extended antecedent record—to and including the year 1880.

TABLE IV.—PARTLY CLOUDY DAYS.

	Jan.	Feb.	March	April
1880	20	12	12	8
1881	14	14	13	12
1882	12	9	14	15
1883	12	14	17	15
1884	16	16	10	17
1885	18	15	18	16
1886	12	13	15	14
1887	15	10	14	14
1888	14	6	10	10
1889	6	12	5	8
Totals ...	139	121	128	129
1890	9	5	12	11
1891	9	6	8	7
1892	5	9	8	8
1893	10	8	10	10
1894	6	11	8	7
1895	11	11	7	3
1896	10	8	5	14
1897	7	7	11	7
1898	13	5	7	8
1899	8	2	8	9
Totals ...	88	72	84	84
1900	11	6	11	11
1901	10	14	6	8

	Nov.	Dec.
1880...	9	10
1881...	2	8
1882..	15	19
1883...	6	14
1884...	9	13
1885...	12	17
1886...	8	12
1887...	12	14
1888...	1	7
Totals	74	116
1889...	7	9
1890...	13	7
1891...	10	5
1892...	8	12
1893...	14	15
1894...	5	11
1895...	6	7
1896...	10	12
1897...	14	13
Totals	87	91
1898...	11	8
1899...	5	10
1900...	6	8

In the first place, it will be noticed that the sunshine percentages for all six of the usually epidemic influenzal months for the first three years after the great pandemic were uniformly low; and lower as compared with the total average for the years 1891-1901 inclusive.

TABLE V.—CLOUDY DAYS.

	Jan.	Feb.	March	April		Nov.	Dec.
1880	7	7	13	8	1880...	12	11
1881	12	6	12	10	1881...	16	13
1882	14	7	10	9	1882...	7	7
1883	16	10	3	8	1883...	8	10
1884	9	10	15	6	1884...	9	13
1885	6	5	7	4	1885...	13	6
1886	11	4	8	11	1886...	8	10
1887	8	12	10	8	1887...	8	11
1888	11	7	12	6	1888...	20	10
1889	12	13	15	16	Totals	101	91
Totals ...	106	81	105	86			
					1889...	16	11
1890	15	16	15	9	1890...	7	15
1891	11	14	16	8	1891...	9	11
1892	16	12	12	13	1892...	13	13
1893	11	14	13	14	1893...	8	8
1894	16	12	11	10	1894...	11	10
1895	12	7	11	16	1895...	13	14
1896	11	11	12	7	1896...	11	8
1897	14	15	12	9	1897...	11	13
1898	13	8	18	16	Totals	83	92
1899	13	15	19	8			
Totals ...	132	124	139	110			
					1898...	11	13
					1899...	11	14
1900	10	14	13	10	1900...	17	12
1901	13	10	17	21			

But, on the other hand, beginning with the recurring epidemic of 1893-94, the sunshine percentage shows a decided increase, except for the seasons of 1897-98 and 1898-99, during the former of which influenza was very moderately prevalent,

while much more intense during the latter; and yet we have had influenza with us more or less every winter and early spring for the past eleven years, though the severity and sequelæ of the attacks may have diminished a little in some of the years.

On the whole, however, as compared with the possible hours of sunshine it will be seen that the daily average number of hours or percentage of sunshine is but a trifle over one-half for the months when influenza has been prevalent. Is this a normal condition? Or, does the group of an equal number of non-epidemic years preceding the last decade and more show a contrast to these data?

Observing Table III., we find that the total number of clear days for the given months since 1880 up to the time of the pandemic of 1889-90 was decidedly less (by 68, see totals) than for an equal number of years since and including that mortal visitation. There were, however, 110 more cloudy days (see Table V.) for the epidemic than for the non-epidemic groups of years. At the same time, there were also 201 more partly-cloudy days (see Table IV.) for the ten years preceding than following the 1889-90 influenzal outburst.

In other words, a more moderate or average state of clearness or cloudiness—as one may choose to express it—prevailed before the "grip" attacked us so virulently; while the epidemic years have been characterised by an extremeness of these phenomena; indeed, the most rational conclusion justifiable from the facts and figures obtained is that non-equability of weather, as pointed out in my first paper, is a marked feature of influenza epidemic; and that a slight relative diminution of sunshine is associated with epidemic seasons. When one considers that less than one-third of the days were clear, and that the hours of sunshine are very few during the short days of the winter solstice, it seems not improbable that somehow *la grippe* likes the darkness better than the light. But it certainly is not inferable from these researches that there is the positive and direct causal relation between the absence of sunshine and

"*die Intensität und Extensität der Grippe*" that Ruhemann would have us believe.

Atmospheric Pressure and Epidemic Influenza in Philadelphia.

Meteorological Study No. 3.

Doubtless the prevalence and direct spread of epidemics of influenza are effected principally by personal contact, unavoidable in the multitudinous social, commercial, and industrial pursuits of a work-a-day, holy-day, and holiday world. Nevertheless, the suddenness and simultaneousness of attack of large numbers of people of all sorts and conditions, and of average good health, naturally constrain to research whether, as Goodhart intimates (in Allbutt's "System of Medicine"), there may not be undiscovered yet probable "subtle influences" in the atmosphere that make for the epidemicity of influenza. Furthermore, one who has lived, practised, and observed through the eleven winters of influenza, including the great initial pandemic of 1889-90, must have entertained some surmises at least that the recurrent peculiarities of meteorologic states may have operated either to inaugurate or aggravate the multiplication and virulence of the bacilli of Pfeiffer; or to develop or increase human susceptibility to the bacillary invasions and toxins.

Without any prejudices or speculative theories for or against this idea, but simply as a working hypothesis, I began an inductive study of the subject, which issued in a paper read before the American Climatological Association, in New York, in 1899, on "The Relation of Local Meteorologic Conditions to the Influenza Epidemic in Philadelphia, Winter of 1898-99." Comparative data for the three preceding winters only were analysed.

The first seriatim study of a single meteorologic phenomenon for a longer period of time was given in the article prepared for the 1901 meeting at Niagara Falls, "The Relation of Sunshine to the Prevalence of Influenza." So far, based upon figures

representing monthly averages, only tentative conclusions could be arrived at, summarised virtually in the term "non-equability"; alternating exacerbations of unusually sudden, somewhat brief, frequent, extreme, and rapid weather changes being associated with successive volleys of influenzal attacks. As to sunshine, it was found that for the ten years from 1890 to 1899 inclusive, "as compared with the possible hours of sunshine the daily average number of hours or percentage of sunshine is but a trifle over one-half for the months when influenza has been prevalent." However, in a comparison with the data for the preceding non-epidemic years (1880-89 inclusive), although a moderate or normal state of clearness or cloudiness was contradistinct to the more marked extremes of the epidemic years—absence of equability, again—at the same time the evidence did not justify the positive inference that there existed a direct causal relation between the absence of sunshine and the intensity and widespread influence of *la Grippe* (as Ruhemann, of Berlin, has suggested).

That atmospheric pressure has been thought of as a possible contributory factor at least, in the environmental conditions affecting influenzal outbreaks, a historical study of the epidemiology of the disease will show. For instance, indirect references have been made by Short, in England, in 1557; by Sydenham, in 1675; by Gluge (monograph, "Die Influenza oder Grippe," Minden, 1837), in gleanings from 1775 to 1833; and later, more directly in the *Württemberg. Correspond. Bl.* of 1858-59 (from "Die Influenza-Epidemie," by J. Wolff, Stuttgart, 1892); by the distinguished German meteorologist Assmann, 1890; Masson, in 1891, and Dignat, in 1898, both in France. The three last named observers offer evidence of unusually high barometric maximums during the epidemics of 1889-97 inclusive.

In a general way it may be said at the outset that a careful survey of the morbidity and mortality of grip cases shows the incidences of epidemic attacks to have been almost invariably during those months recording normally the highest barometric

pressures, *i.e.*, December, January, and February. According to Hirsch and Finkler (*Twentieth Century Practice of Medicine*, vol. xv., Article, "Influenza"), 14·38 per cent. of all the known epidemics occurred in the month of January; 10·86 in February; 8·94 in March; and steadily decreasing to August, with only 4·47 per cent.; beginning at 8·96 per cent. in November; and increasing to 11·82 per cent. in December.

According to Buchan's barometric charts of the world, based upon the corrected mean annual and monthly values, the isobaric lines (observations continued for a number of years) for January show a marked increase in the pressure over the northern continents, especially the Eur-Asian continent—the breeding place or starting area of pandemics of influenza. Writes Professor Davis, of Harvard, in his "Elementary Meteorology," p. 92: "It has been calculated that the mean pressure over the whole earth for the year is 29·89 inches. The mean pressure for the northern hemisphere for January is 29·99; for July, 29·87; and for the southern hemisphere, 29·79 and 29·91. It appears from this that there is a much greater difference between the quantity of air over the two hemispheres in January than in July; and that the change is due to the shifting of an amount of air corresponding to a pressure of 0·12″ over a hemisphere, or a weight of about 32,000,000 tons of air, from one side of the equator to the other every half year." Whether any periodic or irregular variability of these enormous movements of air alone, or in particular association with other meteorologic phenomena, exert any etiologic influences in the propagation of grip epidemics must, in the present state of our knowledge, remain a matter of conjecture merely.

Approaching this question from the limited observations of Philadelphia data (and I take grateful pleasure here in witnessing to the very kind helpfulness of Mr. T. F. Townsend, local forecast official, in obtaining suggestions as well as tabulated figures), Table No. 1 was compiled to show the mean monthly barometric pressures for the usual epidemic months, October to

May, for twelve years preceding and the twelve years since, and including the pandemic of 1889-90.

TABLE NO. 1.—MEAN MONTHLY BAROMETRIC PRESSURES (INCHES).

Non-Epidemic Years.	Jan.	Feb.	March.	April.	May.	Oct.	Nov.	Dec.
1877	—	—	—	—	—	29·93	30·00	30·05
1878	29·95	29·85	29·85	29·71	29·82	29·93	29·87	29·90
1879	29·95	29·96	29·98	29·81	29·96	30·04	30·03	30·06
1880	30·06	29·99	29·94	29·90	29·94	30·00	30·13	29·92
1881	30·03	30·06	29·63	29·77	29·92	30·03	30·07	30·04
1882	30·04	30·03	29·99	29·92	29·90	29·98	30·05	30·01
1883	30·08	30·15	29·87	29·91	29·86	30·05	30·05	30·00
1884	30·02	29·97	29·91	29·75	29·84	30·03	29·97	30·05
1885	30·00	29·86	29·92	29·91	29·84	29·90	29·83	29·91
1886	29·92	29·95	29·81	29·99	29·81	30·06	29·91	30·02
1887	29·94	30·10	29·85	29·89	29·93	29·93	29·96	30·01
1888	30·07	29·98	29·95	30·00	29·88	29·87	30·02	29·96
1889	29·94	30·05	29·80	29·86	29·86	—	—	—
Means	30·00	29·99	29·87	29·87	29·88	29·98	29·99	29·99
Epidemic Years.								
1889	—	—	—	—	—	29·93	29·97	30·06
1890	30·11	30·00	29·94	30·01	29·87	29·80	29·97	29·96
1891	29·94	29·98	29·98	29·89	29·92	29·97	30·07	30·08
1892	29·94	30·03	29·90	29·96	29·87	29·91	29·96	29·96
1893	29·86	30·02	29·95	29·93	29·79	30·00	30·01	30·03
1894	30·05	30·02	29·99	29·92	29·83	29·89	30·00	30·03
1895	29·95	29·88	29·89	29·91	29·95	29·94	30·06	30·02
1896	30·07	29·79	29·88	30·02	29·91	29·94	30·10	30·07
1897	30·02	29·97	29·96	29·99	29·85	30·03	29·94	29·97
1898	29·91	29·98	30·10	29·85	29·83	30·01	29·97	29·95
1899	30·05	29·93	29·84	29·96	29·93	30·09	29·95	29·98
1900	29·96	29·91	29·90	29·90	29·85	30·06	29·93	29·98
1901	29·90	29·82	29·81	29·83	29·76	—	—	—
Means	29·98	29·94	29·93	29·97	29·87	29·96	29·99	30·01

(1) A comparative inspection and analysis of the figures of these two groups of years, twelve of sporadic or non-epidemic years, and twelve of the epidemicity of influenza, fail to justify any generalisation—the means show nothing distinctive whatsoever. Although the barometric variations are matters of but a few tenths of an inch day by day, it is more reasonable to

infer that the daily measurements will show a relation, if any exists, between atmospheric pressure and influenza, instead of the balanced data of the monthly means. Indeed, as may be noticed, the total means for the two groups of years and months of usual incidence are practically the same—29·95 inches. It is quite inconceivable that the slight differences in some of the readings tabulated can really signify anything positive. Taking even the seasons of greatest mortality, as the years 1891, 1892, 1894, 1895, and 1899, the differences of a few hundredths of an inch are comparatively unnoteworthy.

TABLE No. II.

BAROMETRIC MEANS, MONTHLY MAXIMA AND MINIMA.

Years.	Jan.	Feb.	Mar.	April	May	Oct.	Nov.	Dec.
1878-89	30·75	30·83	30·63	30·55	30·39	30·69	30·70	30·81
1890-1901	30·49	30·52	30·44	30·37	30·24	30·39	30·50	30·52
1878-89	28·57	28·97	28·94	29·09	29·33	29·08	28·84	28·67
1890-1901	29·23	29·23	29·25	29·39	29·46	29·43	29·35	29·27

(2) A study of the mean maximums and minimums for the same groups of months and years shows *uniformly* lower maximums and higher minimums of recorded means (monthly) for the epidemic, as compared with the non-epidemic group of years. Nevertheless, as pointed out by both Assmann and Dignat, an abnormal increase in the barometric pressure (highest maximums) occur decidedly at the times of greatest influenzal morbidity; *e.g.*, as observed also in my first paper (*loc. cit.*), at the time of the sharpest onset of the epidemic of January, 1899, the pressure recorded was at the extremely high point of 30·907 inches.

(3) In the same manner, we find that the monthly means of the greatest ranges of barometric record (between highest and lowest points) manifest nothing characteristic. Thus:—

TABLE No. III.
MONTHLY MEANS, GREATEST BAROMETRIC RANGES (INCHES).

Years.	Jan.	Feb.	Mar.	April	May	Oct.	Nov.	Dec.
1878-89	1·27	1·27	1·18	1·01	0·79	0·98	1·14	1·24
1890-1901	1·26	1·29	1·19	0·88	0·77	0·95	1·15	1·24

However, I have noticed in the Weather Bureau records that the greater monthly absolute range was a marked feature of severe influenzal periods as compared with mild or sporadic years, the difference amounting to as much as ·4 inches higher for the epidemic months.

(4) Lastly, as intimated before, the following table with its means of more detailed observations corroborates the suggestion that any relation between meteorologic conditions and the prevalence of influenza that may exist will probably be found in the sudden, frequent, rapid, and extreme variations and alternations of the phenomena occurring on certain days, just before or simultaneous with the influenzal outbursts, and not in data of the means of large groups of monthly and annual recordings.

TABLE No. IV.
AVERAGE GREATEST 12-HOUR CHANGES.

Years.	Jan.	Feb.	Mar.	April	May	Oct.	Nov.	Dec.
1879-89	·45	·45	·42	·32	·22	·32	·39	·45
1890-1900	·685	·562	·474	·39	·28	·40	·44	·56

Thus, as in the case of the investigation of sunshine percentage, the behaviour of atmospheric pressure in relation to epidemic influenza is characteristic in the marked lack of equability; in the absolute daily (sometimes, almost hourly) extremes, and not in the monthly or yearly averages or means.

SOME COMPARATIVE STUDIES OF THE TUBERCLE BACILLI AND THEIR IMPORTANCE IN RELATION TO TUBERCULOSIS IN MAN.

BY E. A. DE SCHWEINITZ, Ph.D., M.D.
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THE fact that there are differences in the virulence of tubercle bacilli obtained from various animals was long recognised before Koch and other investigators recently drew attention to this point. Not only was this difference of virulence noticed in the case of tubercle bacilli obtained from various animals but also in the germs obtained from different organs of one and the same animal, as, for example, man. Some of the best work in this line reported by Lartigau* shows that a marked difference in virulence was noted in guinea pigs and rabbits inoculated with the human germ obtained from different individuals. He found a difference in the virulence of the bacilli obtained from the lungs, from bone or joint tuberculosis; and even in the same organ, as the lungs, some of the bacilli might be found very virulent while others were but slightly so. In cases of pulmonary tuberculosis with ulceration he found that the bacilli might be of feeble virulence, while in acute miliary tuberculosis the bacilli were again of great virulence, and the so-called healed tuberculosis of the lungs might contain very virulent or attenuated bacilli.

In 1894† the writer called attention to the possibility of

* *Journ. of Med. Research*, July, 1900.
† *Med. News*, December 8, 1894.

rendering a tuberculosis germ non-virulent for small animals by cultivating it through a number of generations for several years on artificial media. These experiments subsequently confirmed by Trudeau, taken together with Lartigau's work to which we have just referred, and experiments showing that the tubercle bacilli derived from other animals may change their virulence, depending upon their surroundings in the animal body or on artificial media, naturally suggested the idea that the apparent variation in the virulence of the tubercle bacilli obtained from different animals can be largely explained by environment.

That environment not only affects the virulence but also the morphological appearance can be readily seen from the accompanying illustrations. I had inoculated three sets of flasks of the same culture media with three varieties of human, bovine, swine, horse, avian, and dog tubercle bacilli. Plate 1 of each set shows the appearance after they had been allowed to grow for about a month, Plate 2 after about two months, and Plate 3 after about three months. A careful inspection will show that there is almost uniformly an increase in the size of these various germs, depending upon the length of time that they have been allowed to develop upon artificial media. Those which had grown for the longest time were very much longer and differed in appearance from those which had grown for a shorter time. A similar morphological difference in the germs obtained from the different organs of the same animal can also be noted. If we take, for example, preparations made from a guinea pig that had succumbed to tuberculosis derived from the horse, we will notice that the bacilli from the spleen differ in appearance from the bacilli from the omentum of the same animal, and one would be inclined to suggest that they had come from different animals instead of from different organs of one and the same animal. Again, if we compare the appearance of the germ in preparations from the lungs and spleen made from a monkey which had succumbed to an inocula-

tion with the bovine germ, marked morphological differences can be noted. The same bovine cultures were used for the inoculations as those shown in Plate I. In cultures from the organs of these same monkeys we again notice morphological differences in the germs, especially marked if we compare the appearances of cultures upon different sorts of media, as the egg. It is easy to understand, therefore, how the virulence of the germs obtained from different animals might vary if the morphology of these germs changes so easily.

A chemical study of the bodies of the tubercle bacilli derived from various animals also brings out some points of interest.

As the writer and Dorset noted already in 1895,‡ the cells of the tubercle bacilli are rich in substances of a fatty or waxy character which can be readily extracted by means of ether and alcohol. The work at that time was carried out upon tubercle bacilli which were of human origin only.

We have now completed a similar set of analyses made upon bacilli derived from swine, the horse, the bird, cattle, and attenuated and virulent human tubercle germs. As will be seen from the attached table, there is considerable difference in the amount of soluble matter in these various germs, and not only that, but the virulent human germ appears to be more closely related in its composition to the bovine, just as the attenuated human germ appears to be more closely related to the avian germ, which is, as is well known, not pathogenic for man, but can be made pathogenic by Nocard's method. An examination of the ash of these different germs is also instructive, as it calls attention to the fact that the phosphoric acid content of the ash derived from the human germs is considerably larger than that derived from those of lower animal origin. The composition of these various germs is instructive in showing us that the germs utilise those constituents of the animal body which are very important for life and health.

‡ *Journ. Amer. Chem. Society*, August, 1895.

Following the ideas suggested by a study of the composition of the tubercle bacilli, the use of subcutaneous injections of lecithin in the treatment of tuberculosis has been studied by Claude and Zaky§ with, as they claim, very good results. According to them, the patients improved in health, increased in weight, and the examinations made of the waste products showed that the metabolism occurring in the animal body was well balanced. It is not unreasonable to believe that this unnatural waste could be offset by food which would supply the material especially desired by the bacteria, so that the natural processes of life should be balanced and the organism able to protect itself from the attacks of disease-producing bacteria.

It is not so very long ago that nuclein was suggested as a treatment for tuberculous patients, and while some have reported that with this material, as well as with almost every other form of treatment, good results have been obtained, others have reported unsatisfactory results. The suggestion of the use of nuclein and lecithin was not based upon a study of the composition of the germ. Considered in connection with what we now know of their constitution, it seems reasonable.

The question as to whether or not the bacilli that produce tuberculosis in cattle can produce the same disease in man has received considerable attention within the last year, on account of the conclusions drawn from perfectly unwarranted statements that the bovine germ would not cause tuberculosis in man. Koch, and other writers, seem to have entirely ignored the work that has been done by Chauveau in France and Martin in England, in producing positive and extensive disease by feeding cattle tuberculous material of human origin. While a great many experimenters have pointed out the difficulty of producing generalised tuberculosis in cattle by injecting them with tuberculosis cultures of human origin, Ravenel and others, by using very virulent human bacilli, have succeeded in pro-

§ *La Presse Médicale*, September 28, 1901.

ducing generalised tuberculosis in cattle. As it is well recognised that the bovine germ is usually more virulent for all species of animals upon which it has been tried than the human germ, it would be unreasonable to think that it should suddenly become less virulent for man. Again, tuberculin, a solution of the poisonous substances that the tubercle germs produce, whether prepared from the human cultures or from the bovine cultures, or from cultures derived from other animals, will cause the characteristic reaction in cattle just as the tuberculin prepared from the bovine culture will cause in man as characteristic a tuberculin reaction as will that prepared from cultures of the human germ. The literature contains many references to cases of accidental inoculation of man with bovine bacilli. Ravenel has reported many cases that have come under his own observation either directly or indirectly which prove that man may become infected with the bovine germ. It is true that this infection is usually localised, and in most of the cases reported vigorous treatment of the local lesions will prevent the spread of the disease, although there are cases reported in which a later history showed that the individual eventually succumbed to generalised tuberculosis. To prove positively that man could be inoculated with the bovine germ would of course necessitate experiments upon man. Baumgarten has reported some inoculations made by Rokitansky, in one of the hospitals a number of years ago, where patients who were admitted on account of incurable cancerous affections had been inoculated with bovine tuberculosis material without the disease being produced. The experiments as reported, however, were not satisfactory, because they were made upon people already infected with another disease, and some recent workers claim that cancer and tuberculosis counteract each other. His experiments do not offset the positive cases of accidental infection to which we have just referred.

While direct experiments upon man are, perhaps, not warranted, we have at hand some of his first cousins, the

monkeys, which appear to fill the want for desired material. In an article published in *American Medicine*, January 4, 1902, the writer and E. C. Schroeder make a preliminary report upon some experiments which were carried out for the purpose of learning if monkeys could be infected with bovine bacilli. The results proved that they were, if anything, more susceptible to the bovine germ than to the human germ, and the very generalised character of the disease which was produced can be well seen from the drawings. As a comparative test we inoculated monkeys with the human germ. Boyce and Greenbaum have also produced tuberculosis in chimpanzees by feeding them on bovine bacilli. These results upon monkeys are, I think, very instructive when we recall the recent work in the examination of the blood of various animals. The serum of a rabbit which has been injected with human blood will give a precipitate either with human blood or with monkey blood, and the blood serum of a rabbit which has been injected with blood from a monkey, will give a precipitate with human blood or with monkey blood, although it will not react with the blood of any other animal. The blood of a rabbit, however, that has been treated with the blood from a cow will react only with the blood of cattle, and not with the blood of monkeys or the blood of man. This reaction is another confirmation of the commonly accepted close relationship which exists between monkey and man, and if the monkey is so susceptible to bovine tuberculosis, it is but fair to presume that man would also be susceptible.

The principal danger to man, so far as cattle tuberculosis is concerned, of course rests upon the possibility of his contracting the disease from the milk or meat of tuberculous animals. While it is true that the average number of deaths from tuberculosis in adults is gradually decreasing, it is also true that the percentage of cases of tuberculosis in children is on the increase, and although the amount of intestinal tuberculosis is comparatively small, experiments upon animals have demonstrated that

even when the disease is communicated to cattle by feeding them with tuberculous material from other cattle, the lesions may be found confined almost entirely to the lungs. While we may admit that the possibility of infection from cattle is only one of several sources, nevertheless there is sufficient evidence to prove that there is such a possibility. In caring for the tuberculous and limiting the spread of this disease we should use every possible means to overcome all dangers, and this source of infection should not be ignored. So far as the meat is concerned, as that is fairly well cooked before consumption, if taken from animals which have been carefully inspected there should be but little danger. As for milk, there is no reason in the world why the pasteurised article should not be uniformly used by consumptives and others. Russell, who has made a careful study of the temperature at which tubercle bacilli may be destroyed in milk, has proved very conclusively, both theoretically and practically, that if the milk is heated for ten minutes to a temperature of 60° C. in a closed vessel, the tubercle bacilli are all destroyed. This temperature does not impart to the milk a scorched taste, nor does it interfere in any way with its appearance or consistency or digestibility, and there is no reason whatsoever why milk pasteurised at this temperature under the conditions specified should not be generally used. The work can be conveniently and easily done, and even if milk is only one of the sources of danger it is a source which can be, and should be, readily controlled. Russell's work also demonstrates the fact that if the milk is heated in open vessels the thin pellicle that forms upon the surface of the milk protects the bacilli to a certain extent from the action of the heat, and a longer time is required to destroy the tubercle bacilli than if the milk was heated in closed vessels so that the formation of the pellicle was prevented.

The papers have recently announced that Behring has produced immunity to tuberculosis in cattle by previously inoculating them with an attenuated germ. As I have not seen the

original article I do not know, therefore, the exact conditions of his experiments, and it is unfair to make any comments. That the use of an attenuated germ, however, will produce immunity to tuberculosis in small animals was already noted and reported by the writer in 1894.‖ Subsequently we made a number of experiments, the details of which have never been reported, to see if this same attenuated germ would produce immunity to tuberculosis in cattle. The results were not satisfactory in showing a positive immunity. More recently, MacFadyean¶ has reported some experiments upon cattle which he had inoculated, and concludes that while they did not acquire a positive immunity, they apparently showed considerable resistance to the disease. Whether or not this method would be practical remains to be proven. The fact, however, that the attenuated tubercle bacilli have produced an immunity to tuberculosis in small animals naturally suggested that possibly the contents of the cells of the tubercle bacilli—in other words, their virulent products—might be useful in producing immunity or might have some curative action. That this relation of these products of the germ to the progress of the disease should be more thoroughly studied has been well shown. There is a very poisonous nucleo-proteid and a very poisonous necrotic acid obtained from these germs. Some writers report good results in the treatment of cases of tuberculosis with the products of the germ. Until, however, we know more definitely the nature of these various products—and what we have already said in this paper shows their varied character, as they contain fats, waxes, fatty acids, nucleo-proteids, probably lecithin, glycogen, and other products—they should not be generally used for the purpose of treating the disease in man. These poisonous products secreted by the germ necessarily cannot produce a progressive disease, that is, these substances injected into the

‖ *Med. News*, December 8, 1894.

¶ *Journ. of Comp. Pathol.*, March, 1902.

animal body cannot reproduce themselves as the live germs would do, and the method of obtaining them from the cultures necessarily causes the destruction of the live germ. Hence if properly prepared, the only danger from their use could be the very poisonous properties of the substances themselves which should be considered in connection with the progress and treatment of tuberculosis.

The points which we desire to emphasise in this paper are: That the tuberculosis bacilli generally, no matter from what animal obtained, are susceptible of great changes, both morphologically and in their virulence, depending upon their surroundings. That the composition of these germs of various origin is an important one; that from the study of their composition we can obtain some idea as to the possibility of the way in which the animal body can be aided in its fight against this foreign organism—in other words, what particular substances are needed as food; that the bovine tuberculosis germ is a danger of no mean importance, and that all evidence indicates that man may be infected by bovine bacilli. The possibility of this infection can be diminished by following ordinary sanitary precautions. A more careful examination of the products of the tubercle bacilli may show us that these products may be used directly or indirectly as vaccines or antitoxins for the purpose of treating the disease.

DISCUSSION.

Dr. Otis: I would like to express my hearty appreciation of the value of such a paper and such investigations as Dr. de Schweinitz has presented to us. I had the pleasure of hearing Dr. Koch's paper last year at the British Congress for the Prevention of Tuberculosis in London, and I have rarely witnessed such a dramatic scene as was produced by his statements on that great audience. Although we may doubt as much as we please the truth of Prof. Koch's assertion that bovine tuberculosis is not capable of conveying the disease to man, until more abundant and definite evidence is adduced to the contrary Prof. Koch can remain imperturbable, and ask for our facts in proof thereof. And herein lies the value of such experimental

work, in the solution of this question, as Dr. de Schweinitz has so admirably presented to us.

Dr. DENISON: I would like to add my thanks to Dr. de Schweinitz for his most excellent exposition of this matter, because, it seems to me, it helps us along a great many degrees in getting over what occurred to me, as Dr. Otis has just mentioned, a wrong presentation of this question at the Tuberculosis Congress in London last year. I remember that at Sir John Blythe's dinner, the evening before Dr. Koch read his paper, Dr. Williams came to me and said, in an excited way, "Doctor, we are going to have a devil of a time to-morrow; Koch is going to make some extravagant statements, and he will surely be called down for them." It happened as Dr. Williams predicted, and it was a remarkable scene and a very exciting one amongst the 2,000 delegates present when Koch read his memorable paper, and Prof. Sims Woodhead and Lord Lister spoke in reply.

It seems to me, while this matter is being cleared up, that we can draw the conclusion (from the very fact which Koch introduced, *i.e.*, the question of the differences between the tubercle bacilli in men and in animals), that we must look for a uniform cause beyond the bacillus itself. If the bacillus can exist in so many different forms, is it not reasonable to conclude that there is a uniform cause back of the germ? My hope, in bringing up this point, is that we will in studying this question learn something in regard to the effects of environment upon the germ, and from this learn something of the prevention of the disease. To my mind that study has to come chiefly through an investigation of the air we breathe. It is known in our part of the country that the cattle out on the plains do not have tuberculosis, while those confined in close quarters do have it.

Two years ago, at our meeting in Washington, I expressed the belief that we had more to learn about tuberculosis than all we already knew about it. That is my strong hope. And this excellent report of Dr. de Schweinitz' experiments helps us along towards a clearer understanding of the matter.

Dr. SEWALL: This accurate laboratory method of studying the subject is of course the only one from which we can get reliable results, and it seems extraordinary that this feature of the study has been so long delayed. Thirteen years ago, when I began to have occasion to use the microscope in studying sputum, it struck me that the morphologic characters of the tubercle bacilli conformed in some way with the clinical character of the disease. Similar observations have been noted through the intervening years, and I think we can come to a better understanding of our tubercular patients on the clinical side by taking into account the morphologic character of the bacilli in their sputa. The little, short, deep staining bacilli seem to indicate a rapid progress of the disease or a low resistance on the part of the patient, while the long or sporulated bacilli especially distinguish the very chronic cases. I wish those having the advantages of laboratory training and facilities would carry out these observations, and test them according to the experimental method; for it would be an

enormous help to us as clinicians if we could determine in a definite case the relative virulence of the morbid process we are fighting, or gain a notion of its probable outcome through a study of the sputum.

Dr. MARTIN : I beg to thank Dr. de Schweinitz for this very able paper, and I would like to say in reference to the infection of tuberculosis that there has been a great deal said about direct infection, and a great deal of consideration has been given both to the laboratory side and to the bodily side of the question. There is a predisposition to tuberculosis that is readily recognised in many cases, and I believe that lowered vitality is brought on by certain excesses in youth, perhaps, over-study or what not, and from the laboratory point of view it is not easy to determine whether an attack is by direct infection upon the body predisposed or not. There are many exposures without infection, and *vice versa*. And whether it is toxins in the blood or lowered vitality is difficult to say ; a study in that direction might be of value. I fear the study of the bacillus alone might lead us in a wrong direction.

THE POINT OF ELECTION IN PULMONARY TUBERCULOSIS.

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TUBERCULOSIS in man, like no other disease, selects for the beginning of its battle a certain definite portion of the lung, the apex, while in animals it is usually another locality that is infected. In man the initial focus is so uniformly situated in the apex of the lung that the reports that it is sometimes found in other portions makes one doubt if this is really true. In no necropsy of fatal cases of pulmonary tuberculosis have I failed to demonstrate past or present infection of an apex and usually both apices. That there should be such constancy in this particular, has been attractive speculation for the investigator for ages, and it has brought about some careful observations at different times by those seeking the true explanation of this peculiarity of tuberculosis. Especially is this peculiarity interesting in the face of the fact that all the other infectious diseases that incubate in the lungs set up the initial focus points in the dependent portions. I know of no constant exception to this rule.

Granting that these two diametrically opposite propositions are true, it naturally suggests to one to investigate the reasons for this anomalous state of affairs. There must be some good and sufficient reason why the tubercle bacillus selects for the point of invasion the apex of the lung in man while the organisms of such infectious diseases as pneumonia, influenza, &c., select, if we may use the word, the lower or dependent portions; while

in the bovine the initial lesion is nearly invariably in the extreme superior portion of the caudal lobe.

It has become the fashion in explaining the etiology of diseases of the lungs to sum up the whole question by saying they are attacked because they are the most vulnerable organs of the body, and the reason given for apical infection was that this locality possessed less resistance than any other portion of the lung. Granting that it is true that the lungs are so very susceptible, this within itself would not be a satisfactory explanation of the constant apical infection because all other infections colonize in the lower portions of the lung. There must be some other reason than mere susceptibility. We have grown into the habit of accusing the lung for nearly all our ills, and of accepting the fatal belief that it must succumb sooner or later any way to attack from one of the infectious diseases.

Slightly digressing, and to bring into bearing similar diseases inimical to domesticated animals in reference especially to vulnerability of the lungs, let us follow up the group of infectious diseases, where we at once come upon the fact that 24 per cent. of all mortality in man is due to diseases having the demonstrable primary and permanent colonization in the lung tissue proper. This is true in man, and seeking for a cause we most naturally turn to comparative pathology to see if it is only peculiar to man, and we are not astonished to note that the same relative position is maintained in pulmonary diseases of domesticated animals. If we carry the comparison along we shall find too that "the causation, course and general character of disease of the lungs are practically identical in all mammals" (Hutchinson). Even the anatomical point of election is nearly or quite the same in animals as in man, the one marked and important exception being, as previously stated, tubercle of the lungs. Now the moment one begins to speculate upon these facts his mind invariably comes back to the old theory of the exposed situation of the lungs, their susceptibility and the fact that they are the most vulnerable organs of the body.

This idea of vulnerability and susceptibility of the lungs to infection is very satisfying to one until he attempts to explain the ever constant apical deposit of tuberculosis. To reach any kind of a conclusion one must grasp the question from a wide scope, taking into consideration fully the function as well as the mechanical construction of the lung, together with the history of its evolution.

Among other things we have been told that the lungs necessarily are more exposed to the vicissitudes of weather than any other organ, and as tuberculosis and pneumonia patients nearly invariably give history of contracting "a cold" at the outset, medical men of ancient times naturally concluded that these diseases were due solely to exposure to cold and dampness, and so there has grown up among the laity the belief in the exposure theory. Even the majority of the medical profession still cling tenaciously to this idea. That exposure to cold is merely an incidental factor in the etiology of pneumonia or tuberculosis seems to be a fact, and this applies fully to all the infectious diseases in man as well as in animals. This idea relative to cold has been severely attacked by many, and especially by Woods Hutchinson, when he pointed out that "fatal lung disease in any given race or class, particularly tuberculosis and pneumonia, is in exactly inverse ratio to the amount of exposure to all sorts of climatic vicissitudes. Diseases of the lungs are emphatically diseases of city dwellers" (Woods Hutchinson, "Human and Comparative Pathology").

His position is undoubtedly correct, and to make it more emphatic, attention is directed to the mortality lists of certain cities and states which I shall point out to you. It is emphasised that pneumonia and tuberculosis are diseases of overcrowding and neither is due merely to cold or exposure to cold, or to constant living in dampness or a damp climate.

One will be astonished to find that statistics show that in the cold of the north where the exposures must be severe, there is no greater ratio of fatality from pneumonia in a given number

of population than in the milder climates further south in a population that lives under the same environment conditions. That the percentage of deaths in a given number of cases of pneumonia is very much higher in the north during the extreme winter months there is not the slightest question. This I believe to be due rather to the heightened virulency of the infecting organism at this time than to the cold *per se*. Knowing that there is a greater percentage of recoveries from the disease in the south it is probably true that there are more cases to a given population than in the north. I have no way of ascertaining these figures, however, as the reported death rates are the only figures at hand.

It is quite true that nearly all the cases of pneumonia occur in the three winter months of January, February and March. But this is true of influenza also, and the explanation of one will probably apply to the other; for whatever be the cause, it would also explain the greater frequency of nearly all the acute infections, especially of small-pox. Neither pneumonia nor tuberculosis is due merely to the greater degree of cold. I would seek the explanation for the increase of pneumonia and influenza in these months to the overcrowding and overheating that one sees in theatres, street-cars, and other shut-up, stuffy places where the heat is great enough to desiccate the germs of these diseases which have been planted in such places, mostly by coughing and spitting. Fresh air and ventilation stop all these diseases promptly. If contracting a "cold" is the *sine quâ non* for an attack of pneumonia, we should have the greatest number of cases in the fall and spring, for it is then certainly that we have a greater frequency of chilling of the body. Auto-infection in pneumonia, directly into the lungs from the mouth and pharynx is extremely doubtful. It is probable that the pneumococcus is first ejected by the saliva in spitting and, having dried, enters the lungs in dust, and this is what happens in overcrowding in our city lives.

This question of influence of cold and crowding is very

noticeable if the figures for the smaller and newer towns where there is little over-crowding are taken in comparison with large cities in the same localities. For example, take Boston and Worcester. In 1900, in Boston with its over-crowding, there were 24·98 deaths from pneumonia to every 10,000 inhabitants, while in Worcester there were only 16·12. Making the parallel more remarkable, take Albany with 17·74 to 10,000, and we have Atlanta with practically the same population with 21 to 10,000

In comparing the States it was found that in those that are sparsely settled there is little pneumonia. This is true whether north or south. Minnesota for ten years has 6 for 10,000, a very small rate for pneumonia in a very severe climate. Even California and Louisiana are greater with 9·54 and 11·38 respectively. Taking Chicago out of the calculation of Illinois, it was found that that would make the population conditions about the same as Indiana, and the percentage of deaths in these States are then practically the same, while Georgia, with a little less population than Indiana, has practically the same number of deaths from pneumonia. There can be no doubt that this disease is one of city life rather than life in the country. It is the disease of segregation not of isolation, and it would seem to be a disease of over-crowding rather than exposure to cold; hunger, cold and alcoholism, being merely agents that favour the disease and apparently influence its mortality.

What has been said of pneumonia in reference to exposure and over-crowding applies equally to tuberculosis, as will be noticed by the table on next page, both diseases being shown in parallel columns.

We turn from the theory of exposure of the organ to cold and dust to the theory of its great and constant amount of work without rest; from the idea of complexity of lung tissue, &c., to the one reasonable explanation of Hutchinson, viz., that "the lung represents an adjustment of the body mechanism to an extremely late and recent factor in our environment—the

direct breathing of air." It is undoubtedly true as he says, "that in pathology as well as in biology, the ancestrally old is the individually stable and resisting, and conversely, the ancestrally recent is the individually unstable and vulnerable." Following up this line of reasoning in reference to the lungs, he points out the parallels that the uterus and mammary gland are ancestrally and individually late in their appearance as to the establishment of their functions, and they are the first organs

		Population	Deaths from Pneumonia	Per 10,000	Deaths from Tuberculosis	Per 10,000
1	Boston	500,000	1,260	25·20	1,480	29·60
2	Worcester	118,421	191	16·12	218	18·40
1	Chicago	1,500,000	2,550	17	2,330	15·53
1	Milwaukee	250,000	260	10·40	420	16·80
1	New Orleans	265,000	500	18·87	980	36·98
2	Buffalo	352,387	559	15·86	464	13·16
1	Philadelphia	1,200,000	2,500	20·83	2,630	21·91
1	San Francisco	320,000	580	18·12	960	30*
2	Los Angeles	102,479	128	12·49	380	37·08*
3	New York City	3,400,000	9,070	26·67	9,460	27·82
2	St. Paul	163,065	133	8·15	206	12·63
1	Minneapolis	190,000	225	11·84	260	13·68

1 = Average for 10 years.
2 = 1900.
3 = Average for 4 years.

* Very high because of imported cases.

STATES—CENSUS OF 1900.

California (outside San Francisco)	1,142,271	1,090	9·54	2,421	21·19†
Georgia	2,216,331	2,598	11·72	2,651	11·96
Illinois (outside Chicago)	3,122,975	3,331	10·66	3,752	12·01
Louisiana (outside New Orleans)...	1,094,521	1,252	11·38	989	9·03
Maryland (outside Baltimore) ...	600,093	946	15·76	1,195	19·94
Minnesota...	1,751,394	1,379	7·87	1,844	10·52

† Imported cases from other States make these figures too high.

of the body to fail and atrophy before the age-period of general senility, and their pathological record is one of the blackest, especially as to cancerous diseases.

There is no doubt of the soundness of his grounds in this particular as an important factor, but when he would have us accept it as the sole factor, discarding dosage, specificity of

different organisms for certain organs of the body, then we must refute that portion of his theory deemed to be in error. It is not denied that his theory satisfies the investigator in a general way until one attempts to make his theory apply, not only to explain why the lungs are so vulnerable, but why one locality of the lungs is more susceptible to a particular disease than another part of the lungs. This is especially true when he would have us believe in the greater vulnerability of the apices, for he regards "tuberculosis as a disease preferring not only the most unstable organ in the body, but the most unstable regions of that organ, and of those regions, that side of the median line in which retrogression is still going on. It attacks the weakest side of the weakest part of the weakest organ in the body." But here his theory is too finely drawn to satisfy, and one turns to comparative pathology where we so often find solutions to puzzling questions.

Of course we must admit that in the upward trend of evolution, as each complex organism acquired a new organ by virtue of the needs of its changed environment, that this organ had to follow the well established law and fight its way, so to speak, to stability and permanency of function. We must not lose sight of the fact also that side by side with this assumption by new organs of new and complex functions that there has followed in the evolution of the lower forms of life, the different specific organisms of disease which have attempted to live and thrive in the new organ as the host. The stomach, one of the oldest organs in animal life, has fought its different battles for millions of years, and yet the changed environment of man, his over-crowding probably, has brought the stomach in contact with a new enemy in cancer. Freely granting in the main the applicability of the great law of evolution in its bearing on the recentness and remoteness of an organ in its sphere of usefulness and defence from attack, it is nevertheless perfectly plain that the organ is attacked not merely because of its newness but rather because of its lack of experience in combat with

that particular new enemy. This would seem to be true of the stomach and cancer and of the skin and cancer. We find examples of this even in plant life, where the most hardy species in one environment become quite the reverse in another, and are free from diseases of all kinds in their old home, but are generally attacked in their changed *habitat*. Here species longevity has nothing whatever to do with susceptibility to specific attack, and this has reasonable bearing on our subject when considered in connection with Koch's iteration of Theobald Smith's investigations that human tuberculosis as a fatal, progressive disease is not communicable to bovines, and the probability that bovine tuberculosis is not readily transmissible to man. Here certainly it is either one or all a question of exact kind and exact amount of nutritive material under the exact biothermal condition which makes the bacillus grow, together with the original or the acquired specificity of the bacillus, rather than the remote influence of an ancestral type of host. Taking these bacilli, the human, bovine and avian, that produce nearly identical lesions, it seems reasonable to believe that here the differences in their individual specificity must have been brought about principally by the element of nutrition and cellular heat in the animal species attacked. In this instance one must not lose sight of this most important fact, that although human and bovine bacilli are similar generically and otherwise, nevertheless one chooses man as its host, and will not develop readily in cattle as a fatal disease, and the other chooses cattle as its host and will probably not grow in man. And keeping in mind the inherent characteristics of these two bacilli we are certain that while each possesses a certain character and specificity of its own it will not grow when planted until it finds the exact kind, the exact amount of nutritive medium under exact and necessary biothermal conditions. And to make it still plainer, one can understand that if it be a fact that the two bacilli are different in the matter of specificity, the human bacillus entering the cow's lungs, as it certainly must, acts merely as a harmless foreign

body. The converse of this is probably true of the bovine bacillus in its relation to man. There must be not only susceptibility of the animal but the necessary virulence of the micro-organism itself. It is only a question of a new host and a new enemy under changed environment, and the great law of survival of the fittest has to be strictly applied. In thinking of the transitional and retrogressional changes in ancestral type our minds can only grasp at great cycles of time, while if we think of the changes wrought by the attack of a new disease it is suddenly and terribly near to the present day. Millions of years from now the lungs of man living in remote and primitive conditions, which have never been exposed to the tubercle bacillus or the pneumococcus, will succumb as quickly and promptly to infection from these organisms, under the same environment conditions, as they do at this time.

So it seems to be with our lungs, that it is not merely a question of ageing and successful struggle of an organ in the past, but to the question of the present combat with a new enemy. And so I am sure it is with the uterus and mammary gland, for admitting the contention relative to the uterus and mammary gland, if so unstable and subject to attack in reference to cancer, then why not to tuberculosis? We cannot sustain the parallel "last to come, first to go," for again comparative pathology teaches us that in animals these organs are very stable and not frequently attacked with disease. This is even so with tuberculosis, for in the cow we find the percentage of udder infection comparatively low and the uterus, one of the newest organs, rarely infected. The male organs of generation have enough similarity to the female organs to apply the law relative to ancestral type, and yet we find that they do not succumb to carcinomatous diseases nearly so readily as does the uterus. The ovaries and testicles are rarely attacked with cancer but more often with tuberculosis. Following in the same line of reasoning we come upon the peculiar fact that the negro race, regardless of environment, is

nearly exempt from carcinomatous infections. Especially is this true of carcinomatous tumours of the uterus, and it is hardly likely that the uterus of the negro has worked out its evolution and become immune to cancer. It surely can only be a question of the necessary kind of nutritive medium or a lack of exposure. At this point one's mind naturally reverts to the comparatively recent diseases of gonorrhœa and syphilis in connection with our subject, and we ask the outcome of experimental inoculations with these diseases in animals.

The more we think of the matter the more puzzling it becomes. Why does the typhoid bacillus select for its final stand in the fight, Peyer's patches? And why in the young adult in preference to children or old adults? Why does the diphtheria bacillus select the upper air passages for its final growth? and why in children? And why does the tubercle bacillus entering the circulation from the lungs of the child as it certainly must, grow in the meninges more frequently than in the lungs? Then why do animals escape infection from measles, small-pox, syphilis, scarlet fever, typhoid fever? And, coming more to the question, why does the pneumococcus select the lower portions of the lung of the adult and the tubercle bacillus the extreme apical?

The morphological age of the lung, the recentness of this organ in mammalian life, the intricacy of mechanism, and such other explanations, cannot satisfy us in the face of so many contradictions, not only in man but in mammals. If we apply Hutchinson's theory of unstableness and recentness of an organ to explain its susceptibility in animals, it is only reasonable that it be applied in like manner to the feathered tribe, whose lungs are certainly more recent than their livers, and yet it is this old organ that is nearly always infected in avian tuberculosis. Parrots brought into captivity and crowded together succumb quickly to tuberculosis of the liver and other abdominal organs, the lungs being the very last to become infected. Here the question is mainly one to be settled by the formula of exact

amount of nutritive medium and especially of exact *bio-thermal* condition which are necessary for the growth of the avian bacillus in the organ attacked, in this instance it being the liver.

If the law of unstableness applies to one disease it must of necessity apply to all; and if it is applicable in explaining the most frequent initial site of a given infection in a certain portion of an organ, it must apply in like manner to all other infectious diseases in their selection of a site for colonization. And if the law of unstableness applies to an organ at one time of its life, it must of necessity apply to all portions of its life.

For example, if the apex of the lung is less stable and more vulnerable than the lower portions, we should naturally expect that section to be the constant focus and battle ground of infection. But just here we meet obstacles that are not so easily explained away. We turn to comparative pathology again to find the apex of animals not the most frequent site of attack in tuberculosis at all, but the away-off caudal portion of the lower lobes, that portion corresponding to our extreme dependent portions; and in both man and animals we find quite another portion of the lungs the site of pneumonic infection. To say that "it is generally admitted that while the respiratory cavity in mammals is undergoing progressive limitations at both its cephalic and caudal extremities, in man at least, these changes are most active at the cephalic end" (Hutchinson) does not satisfy us in the face of the fact that pneumonic infection is nearly invariably at the dependent portions of the lungs in man and animals; tuberculosis at the apices in man (and probably also in the monkey, though I have been unable to ascertain this), and the extreme caudal portions of the lung in the cow. And while the attempt is made to show that this retrogression of the lungs at both ends accounts for the infection of the caudal lobe in the cow, we find that this corresponding portion of lung in man is the very last to become infected. And coming back to the cow we note the fact that it is not the very tip end of the lung which is infected, but that the infection is at a

delimiting line some little distance below the superior surface of the caudal lobe. Furthermore, it is impressed upon one that it is the *superior* portion of the caudal lobe that is infected, while the *dependent* portion of the same lobe which must be undergoing retrogression at least as much as the superior portions, escapes infection until very late in the disease. In pneumonia the dependent portions of the lungs are the most frequently infected, and apical pneumonia as the initial lesion in man is one of the rarest forms, and even when found must be put under the ban of suspicion as a tubercular pneumonia.

All kinds of ingenious arguments have been advanced to explain why in tuberculosis the invasion is nearly invariably at the apices and not in the lower portion of the lungs where we would naturally expect it if bacilli are inhaled and carried directly to the air sacs and implanted there. For it is but natural for us to believe that tubercle bacilli as well as other germs of disease must be heavier than air and necessarily must respond to the common law of all ponderable bodies; and in this particular instance at least contaminating the lower stratum of the air columns quite as much as the upper. The well-known fact that no amount of forced inspiration would be able to drive bacilli or dust immediately and directly to the air sacs; and the further physiological phenomenon that the residual air column makes its mechanical exchanges by the transfusion of gas in the bronchi; and that the intake of tidal air in its various excursions up and down the trachea and bronchi, and finally the smaller bronchi must inevitably impinge the foreign body of a bacillus on the cilia and mucous membranes, makes us doubt if bacilli ever actually reach the air sacs and are deposited there. Unless we keep the histology of the bronchi and air vesicles well in mind we are liable to form unwarrantable conclusions. We know that coal-dust cannot penetrate the basement membrane and fibrous coat of the bronchi, and that it only reaches lymphatics and blood vessels by penetrating the wall of the air sac or the walls of the membranous bronchioles. The re-

placement process is a mechanical affair, and probably takes place in the small bronchioles just at the junction with the air sac. The important statement that the heated air of the lungs naturally rises to the upper part of the lungs, leaving us to infer that by rising it carries bacilli with it, must be fallacious, for air saturated with carbon dioxide is heavier even than cold air, and in any event, we see that it is not true that the heated air rises to the upper portion of the lung. "The process of aeration of the blood, therefore, has none of that intermittent character which attends the muscular movements of respiration, which would undoubtedly occur if the entire gaseous contents of the lungs were changed with every respiratory act" (Flint).

The assumption that the heated air of expiration is lighter and rises is unwarranted, for the admixture of carbon dioxide and air takes place by transfusion just as readily at the apex as at the base, 95 parts of oxygen replacing 81 of carbon dioxide, making the current at the mouth of the air vesicle, if there be a current, in toward the vesicle rather than outward.

We turn from one theory to another searching for an acceptable explanation. We find that the posture necessarily assumed by certain labouring classes has brought forward the elucidation of the theory that the chest being constricted at the apex, its walls being firm and nearly fixed, the absence of elastic buffers tends to limit the respiratory rhythm and even to reverse it, the reversal of the air current being used to explain the causes for apical infection. Colbeck and Pritchard, in an article in the *Lancet* of June 8, 1901, make the claim that the movements of the apex of the lung must be inverted in regard to their relation to the normal respiratory rhythm.

That the respiratory rhythm is inverted at the apices appears to be untenable if viewed from the physiological diffusion of gases in the lungs. To sustain an acceptable explanation of this kind it must apply in like manner to animals, and when we turn to the cow, for example, we find that the theory falls to the ground. There can be no inversion of the respiratory

rhythm of the cow's lungs at the extreme superior portion of the caudal lobe. So far as the respiratory rhythm is concerned it has very little direct effect on the air vesicles except in forced inspiration. And furthermore it seems highly improbable that the human ear can be so educated and perfected as to be able to detect a diminution in pitch even if respiration were reversed at the apex.

One of the most attractive theories for the selection of the apices for tubercular infection is that of Albert Abrams, which is based on observations with the radioscope. His vast experience with this instrument has perfected him in its use to such an extent that he claims to be able to map out certain portions of the lung which darken the screen in different degrees. These shadows he has designated "atelectatic zones," "and the atelectatic zones have an almost definite relation to the points of election and paths of distribution of the lesions in chronic pulmonary tuberculosis."

He does not specifically claim that these zones are the cause for the initial lesion, but the inference is plain.

The sequential thought is, that here is a plausible reason for apical infections; here is lung tissue temporarily put out of action; lung tissue that for the present is not well drained; lung tissue that would be more apt to become infected because of the retention of the bacillus if such were present, and that tissue which is functionally inactive is more susceptible to infection.

That these zones are temporary is acknowledged. That they do not become permanent atelectatic infarcts is positive, for in that event they would give us a permanent shadow, and the demonstrations of necropsic findings of tubercular and other fatalities would show us a picture not to be forgotten or readily overlooked by the careful observer. The pathology of congenital and acquired atelectasis is well known, and we must not forget that in the permanent form, that condition found after death where the air vesicles have become obliterated and

the tissue changed, is usually at the lower portions of the lungs. In all my searching for years I have never seen it at the apices except small areas shut out by the encroachment and pressure of recent tubercular deposits on bronchi. It is often found in the lower portions of otherwise healthy lungs; and in all the examinations which I have ever made I have never found permanent atelectatic tissue infected with tuberculosis. That such tissue is immune to tuberculosis is probable, and even in the congenital variety this seems to be true. That such tissue is not infected makes it all the more probable that infection of the lungs of the fœtus *in utero* is extremely rare.

Furthermore, the etiology of these fluoroscopic zones must be different from the ones met with in necropsic findings. We know that in the permanent form the air vesicles belonging to the bronchial tree are destroyed by plugging off the intake tube, thus causing the total destruction of the air sacs supplied by this bronchial tree. Lung tissue that is shut off from air is abundantly supplied with blood, and if not restored to function undergoes connective tissue change. Atelectatic tissue is so typical that it could not be mistaken for any other condition.

Granting that these temporary zones are more frequently noted at the apices than at the lower portions of the lungs; admitting that such a condition would make infection more probable in the temporary infarct; passing over the fact that there is no tubercle infection in congenital atelectasis, we are nevertheless unable to explain away the point of election and the primary site of bovine infection. And if this condition does prevail and we are to apply it as a cause for apical infection, one fails utterly to understand why then the apices are not more frequently the site of pneumonic infection, for the same conditions should apply to both diseases and to all diseases that incubate in the lungs.

The old theories that the return blood circulation of this portion of the lung was imperfect, that the respiratory function here was diminished from restriction of the chest and many

others too numerous to mention, have been easily explained away.

Just here I wish to mention some of the findings incidental to a wide range of necropsic examinations made in part to seek a reason for apical infection in tuberculosis.

Attention is directed to the condition of the lower lobes in fatal cases. We have been led to believe that the progressive steps of the extension of the disease are caused by aspiration of the mucus—a backward extension along the bronchi. Our distinguished member, Norman Bridge, has recently called attention to the infection of one apex from the other by gravitation of the sputum into the bronchial branch to the opposite apex. He believes this to be true, and for this reason he cautions his patients to sleep on the affected side. Surely this method of infection by the backward flow of sputum, is one of the rarest and would lead to the constant secondary infection of the lowest part of the lower lobes so soon as the primary focus in the apex broke free into the small bronchi. We know perfectly well that the mode of infection is from near the surface of the dome of the apex gradually downward toward the lower part of the upper lobe to its base, the line of demarcation between the two lobes, the upper (the apex) and the lower, being well defined until late in the disease.

The infections of the lower lobes come late in the disease; and even here with the tremendous amount of mucus and the inability of the patient to raise it, we find that the deposits have commenced at the extreme outer surface of the lobe just under the visceral pleura deep down behind and not contiguous to the large bronchi. If we examine closer we find in the majority of cases that these deposits have not even broken free and have no open communication, and they are usually so widely separated as to make it impossible to believe that the extension of the disease was by continuity or even along the route of a continuous lymphatic chain. We notice deposits so widely distributed and disseminated that it is not easy to

believe the extension of the disease has been other than by a screening out from the blood-vessels. In these cases, too, we find the great bronchial glands enlarged and badly damaged, and all the small glands are indurated and enlarged. When the tubercular process is slow there is formation of tubercles and scar tissue, while if the infection is very fulminant and virulent bacilli are being poured into the blood to be screened out by the lungs, the intoxication is then very intense and the tissue is overwhelmed so rapidly that it only forms exudates, the exudate pouring out into the vesicles and choking them like a true pneumonia (Lartigau). This would explain the presence of tubercle bacilli in the exudate in the air sacs in fulminating miliary tuberculosis without lesion of the air vesicle—typical tubercular pneumonia.

On the apices we invariably find the bluish deposit of coal-dust or hæmatoidin or both together, in and just under the visceral pleura, and by carefully cutting down we can notice in many cases the delimiting line with the naked eye. The apical visceral pleura is much darker than on the lower portions of the lungs, but if we go into the lung substance proper we notice that the lymphatics of the lower lobes also contain a great abundance of the material, while the bronchial glands are often so gritty that one can feel it with the knife. The deposits of pigment and carbon in the lung tissue correspond exactly with the lymphatic distribution, the largest deposits being in the glands or contiguous thereto, and the finely divided, impalpable dust which causes the discolouration show greater deposits in the extreme outer surface of the apical portion, some of the dust passing across the pleural lake to the parietal pleura and lymphatic glands beyond. The larger particles certainly answer the law of gravity and reach the lower portions of the lung, but why do the minute particles seek the apex?

There must be a mechanical cause for this, for we find that in long and constant exposure to coal-dust that the colouring from this deposit on the visceral pleuræ gradually fades from

above downward and from behind forward. In speaking of the destruction of lung tissue caused by anthracosis, Hektoen says that "for an unknown reason, the most marked lesions seem to occur in the apical portions of the lungs." The cause is purely mechanical, and we cannot for a moment entertain any other idea.

We are prepared to admit that in the respiratory air excursions it is more than likely that even the finest particles of dust or foreign bodies would finally impinge on some portion of the bronchial mucous membrane, and calling back to mind the histology of this mucous membrane it would seem that such bodies would be expelled by the cilia. This is true in the main, but where there is such a constant admixture of foreign matter with air a part of it does reach the air-sac and is then dealt with in another manner. A common sight familiar to all of us is in looking through a bright pencil of sunshine which is coming into a room, we see the moving particles of dust constantly oscillating and changing position. Our patience never rewards us in seeing what is the final outcome of these particles, for they certainly remain and carry on their never-ceasing motion during the stay of the sunshine. We can imagine the millions upon millions of soluble foreign bodies, harmless bacteria, the non-pathogenic spores and rods of low plant life, that, in our dusty city life especially are constantly inhaled: and being inhaled myriads of the impalpable dust and carbon particles, spores with their rods and other bacteria, enter the air vesicles and probably penetrate their walls, entering the blood current direct, or more often the lymph channels, to be wafted about, here, there, challenged at this post, arrested at that, being finally engulfed and swallowed up—digested likely by our efficient constabulary force, the phagocytes. After all, this is not so hard to believe of microscopic matter.

The hæmatoidin deposits in the lungs must not be mistaken for actual coal-dust deposits. After the age of forty there is always more or less pigmentation of the lungs, being

greater at the apices and shading off toward the base. In the bovine lung there are deposits of pigment also.

The assumption of this paper is that human tuberculosis is only transmitted by means of inhaling dried sputum. Whether one case is infected directly from another in an endless chain, or whether the contagium is universal and the disease is only contracted because of lowered vitality incident to life in squalor and over-crowding, as Quimby believes, does not alter the question. That there is some other agency at work in the spread of bovine tuberculosis we have reason now to believe, since Theobald Smith has demonstrated to our satisfaction that bovines are with difficulty infected from human bacilli. That there may be some other method of spreading the disease to man than by sputum, furnishes us an attractive speculation.

And it is well to state here that one's belief in Smith's and Koch's investigations must be limited, because neither of them have carried these experiments as far as they should. Each acknowledges that human bacilli caused limited local infection in bovines, and we cannot feel perfectly safe over this until recovered bacilli from such cases are carried on through other bovines to see if a typical bovine virulence and specificity can be established. Salmon and Ravenel have summed up enough evidence to make it necessary for caution, especially since the matter involves the commercial side to such a great extent. The question after all as to difference may be one of exact biothermal conditions which might cause one or the other to become specific to a different species where there was constant exposure. We know that the cow's normal temperature is considerably higher than man's. And this calls to mind that Nocard implanted into the abdominal cavities of fowls human tubercle bacilli imprisoned in collodion capsules and thus converted the specificity of the human tubercle bacillus to that of the avian tubercle bacillus. There have been other experiments somewhat similar to this with practically the same results.

I cannot but believe it probable that a child constantly

dosed with tuberculous milk will eventually become tabetic. I also believe that constant intravenous injection of large amounts of human tubercle bacilli will finally give the cow general tuberculosis.

Recalling the histology of the air vesicle and its immediate environment, and keeping in mind the method by which such foreign bodies as coal-dust are cared for by the lymphatics and blood-vessels, it is reasonable to believe that the bacillus penetrates the thin wall of the air vesicle to the capillaries of the blood-vessels and lymphatic channels lying immediately below, without so much as *leaving evidence of its passage.* So soon as it reaches the blood-vessel or lymphatic, it is carried along just as is any foreign body. Most of the bacilli enter the lymphatics and are finally arrested and destroyed in the powerful bronchial glands. We know this must be true, for in bovines as well as in man these glands show a greater percentage of infection than any other part of the body and bacilli could not reach them in any other manner. In sixty bovine necropsies by Theobald Smith the thoracic glands were infected in twenty-seven without infection of the lungs. "Pizzini inoculated lymph glands from forty people who died of accident or acute disease, into guinea-pigs. From the results of the inoculation experiments he concluded that 42 per cent. of healthy people have tubercle bacilli in their glands, mostly in the bronchial" (Lartigau).

Like a great many I have believed that the tubercle bacillus gained entrance to the lymphatics and blood vessels through the tonsils, nasal, pharyngeal and bronchial mucous membranes, thus finally reaching the lungs. To infect the apices by these routes the bacilli would have to travel against the lymph stream or enter the blood vessels direct, reaching the lungs through the right side of the heart. That the lymph current was ever reversed is out of the question. And when one had found an apparently acceptable theory for apical infection by either or

any method it was immediately upset when applying it to explain the site of bovine infection.

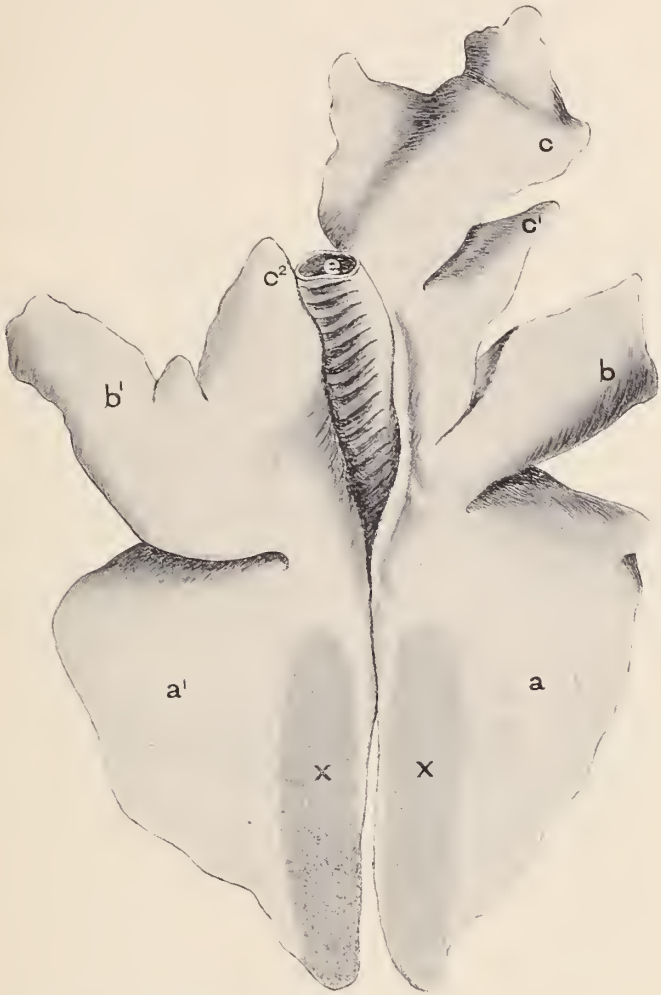
To understand the *modus operandi* of bovine infection and the anatomical parts involved, I have to refer you to this chart of the cow by Süssdorf, and a drawing of a bovine lung from Smith. It is a fact that over 60 per cent. of bovine pulmonary infections are in the extreme superior tip of the caudal lobe, back nearly to the diaphragm. Lying superiorly to the locality usually affected are the aorta, the œsophagus, the thoracic duct and several glands, one of which, the posterior mediastinal, is very large. Lying between this gland and the lung proper are the parietal and visceral layers of the pleura, enclosing of course the pleural lake. The anatomy of this seems plain and one must keep this arrangement well in mind to grasp the contention I make.

The areas drained to this gland are the superior portion of the diaphragm, the pillars of the diaphragm and the surrounding contiguous parietal pleura. That a gland of this size (4 to 6 inches long and about ½ an inch thick) would have a considerable pulling force to the currents in its lymph radicals, is probable. That this must be true is reasonable to believe, since this gland contains foreign matter and pigment. Theobald Smith and others, have demonstrated positively that this foreign matter and pigment comes from the lungs. To make it more reasonable to believe, it is pointed out that in large experience of necropsic work in cattle this same writer noted in reference to the infection of the thoracic glands that "among the bronchial set the left bronchial is most frequently involved. Among the mediastinal the large caudal gland is the favored seat of tubercles. This gland, on the whole, is perhaps more often found diseased than any other thoracic gland, and hence any other lymph gland in the body." Out of 53 cases he found this gland infected in 34.

Now fixing the anatomy of this gland and its immediate surroundings in our minds it must be perfectly plain that the

DORSAL ASPECT OF THE BOVINE LUNGS.

Reproduced from Theobald Smith's Investigations concerning Tuberculosis.



a, a'—Right and left caudal lobes, respectively.
b, b'—Right and left ventral lobes.
c, c'—The two portions of the right cephalic lobes, denominated first and second cephalic lobes.
c²—Left cephalic lobe.
e—Trachea.
x—Region most frequently involved in the earliest stages of pulmonary tuberculosis. The lesions in this stage are, as a rule, embedded in the lung tissue so as to remain invisible from the surface.

foreign matter and tubercle bacilli could only reach this gland either by being screened out of the blood-vessels which traverse it, by a backward flow of lymph from the thoracic duct or by being drawn across the pleural lake from lung tissue through the stomata that exist in both the visceral and parietal pleuræ.*

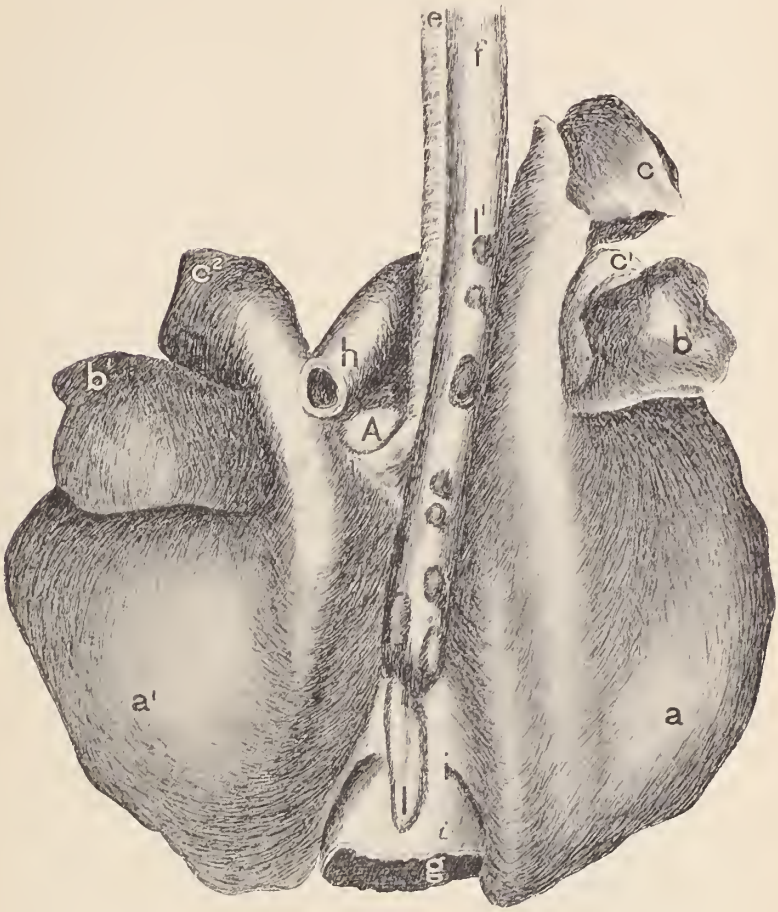
The claim is made that tubercle bacilli, like coal dust, enter the air vesicles, penetrate their walls as simple foreign bodies and work their way to the lymph vessels in the direction of the current of the strongest pull. In the case of the extreme superior portion of the caudal lobe of the cow there must be an area, a delimiting point, where there is more or less stasis in the lymph flow because of the pull across the pleural lake by this large mediastinal gland and the counter flow of lymph toward the bronchial glands in an entirely different direction. Because of this lymph stasis a bacillus escaping into the peri-alveolar tissue would more likely become arrested and incubate at that point, especially if the lymph currrents have been interfered with by previous disease. I feel convinced that many of the bacilli entering the air vesicles of this portion of the caudal lobe are sucked across the pleural lake, through the stomata into the lymph radicles running directly to this large mediastinal gland. It is unreasonable to believe that they reach the gland in any other manner. I believe that the pull, the *vis à fronte*, in the angles of the neck of man creates enough suction to cause an area of lymph stasis in the apex of the lung—a portion in which the lymph current is more or less sluggish.

If this is true, there is sooner or later a bacillus arrested in the peri-alveolar tissue and a tubercle is formed. If this spreads and breaks down it very soon badly damages the lymphatics and bronchial glands receiving the lymph radicles

* The disease of sheep caused by the bacillus of Preisz, known as "pseudo-tuberculosis" or "caseous lymph adenitis," gives typical demonstration of the method of infection from the lung to the superior mediastinal gland.

POSTERIOR MEDIASTINAL GLANDS.

REPRODUCED FROM THEOBALD SMITH'S INVESTIGATIONS CONCERNING TUBERCULOSIS.



a, a'—Caudal lobes.
b, b'—Ventral lobes.
c, c', c²—Cephalic lobes.
e—Trachea.
f—Œsophagus.
g—Muscular pillars of the diaphragm.
h—Posterior aorta cut through just beyond the arch and reflected so as to uncover the left bronchial gland a, resting against the root of the bronchus.
i—Caudal margin of the ligament of the lungs (ligamentum latum).

The mediastinal glands are shown, most of them resting on the œsophagus. The aorta, fat and pleural layers which enclose the posterior mediastinal space laterally, are removed.

l—The large caudal gland resting below the œsophagus on the pillars of the diaphragm. This gland may be left in the body when the lungs and heart are removed unless special care is taken.

The remaining mediastinal glands are arranged in two sets on the right and the left margin of the œsophagus. In this animal there is but one gland in the left chain. l is the gland most frequently diseased, and in many cases enormously enlarged.

l'—The most cephalic of the mediastinal series.

from that locality. After great damage has been done to the lymphatics bacilli begin to penetrate the walls of the blood-vessels to make the circulatory excursion, returning to the lungs to be screened out again. And while it may excite astonishment to think that these virulent bacilli have been making a jaunty submarine trip through our livers, our spleens, our brains even, the amazement is all the greater that they have not been arrested in these organs. The lungs are the screens for picking up foreign bodies from our circulation. This is reasonable to believe, for it is nearly always the lungs that arrest emboli; and pathogenic micro-organisms from other localities of the body do enter the circulation and are usually screened out in the lung tissue, giving us an infective pneumonia. It is almost impossible to convince one that minute foreign bodies can travel about freely in the blood and our minds repel the idea that micro-organisms can circulate promiscuously without causing serious trouble.

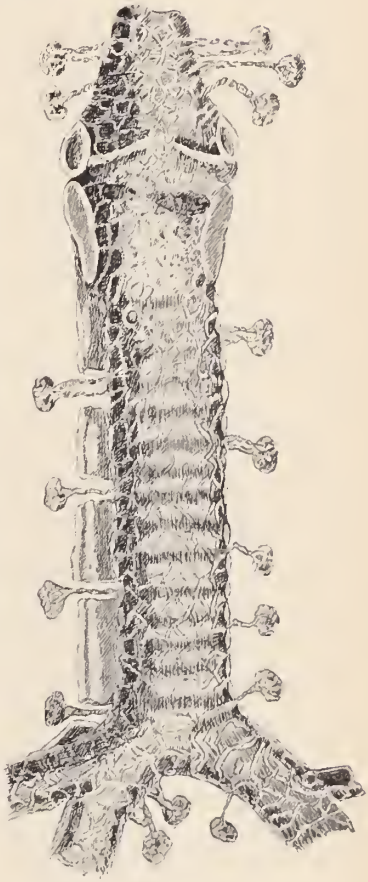
If it is not true that bacilli circulate in our blood vessels and are screened out in the lungs, how shall we explain the deposit in the lungs from gluteal or other cold abscesses, or from aroused tubercular rectal sinuses or the secondary infection of one apex following the primary lesion of the first? And how shall we account for tubercular meningitis in children if bacilli have not penetrated a mucous membrane and entered the blood-vessels? As Hutchinson and Smith say, however or wherever introduced, tubercle bacilli invariably turn up in the lungs sooner or later.

I am not advancing a new idea relative to the infection through the blood-vessels, but only insisting that the idea is correct, and attempting to show in detail why it is correct.

To strengthen this idea somewhat your attention is invited to the clinical fact familiar to all of you, viz., infection of one apex is usually followed by infection of the other apex, *before there are clinical manifestations of the disease having extended to the lower lobes.* It must be perfectly plain that if the infection were planted direct by means of aspirated sputum that it would

LYMPHATICS OF THE LARYNX AND OF THE TRACHEA.

Reproduced from Sappey's Atlas.



"These vessels are remarkable by their number and their development. They are seen to be especially numerous at the level of the upper orifice of the larynx. They spread themselves with extreme abundance over the mucous membrane of the ary-epiglottic folds. They cover also all the surface of the epiglottis, and every other point of the laryngeal mucous membrane, forming, however, in this situation a network many times smaller; this mesh unites into two or three trunks on each side, which pass along the middle portion of the thyro-hyoid membrane, to empty themselves into the group of glands situated to the right and left of the larynx, under the sterno-mastoid muscle.

"The mesh which is to be seen on the mucous membrane of the larynx retains the same character in its course along the whole length of the trachea and bronchi. The numerous small vessels which branch off from them at a right angle are almost lost in the glands which are placed on either side, ladder-wise, in relation to these canals."—Brown.

All the bronchial and tracheal lymphatics communicate with the deep cervical lymphatics and empty with them into the subclavian.

be the lower lobe of the affected side that would follow in the train of infection rather than the opposite apex. It is unreasonable to believe that aspiration of mucus will explain the secondary deposits in the other apex across on the other side of the chest, and too, in the most superior portion of that lung. And another point is that the march of the disease is always from above downward until quite late in the course of the disease when other foci may be established here and there in the dependent lobes.

I believe that all portions of our lungs are exposed alike to an equal degree of infection and that bacilli of themselves have no selective power for any particular portion of the lung tissue, the deposits of tubercles being purely from mechanical causes. I believe that once they gain a permanent foothold they will grow as well in one part of the lung as another.

To bring out a practical side of the question it would seem that an arrested case of tuberculosis of the lung is never safe again, for the reason that the bronchial glands draining that particular section of diseased lung are usually infected and if infected must to a large extent lose their function of arresting foreign bodies; and a softening tubercle will pour its bacilli into the channel of least resistance—the blood capillaries—and the bacilli will have to be screened out in the different portion of the lung tissue to eventually cause new deposits. After the lymphatics and bronchial glands are practically destroyed there is no hope for recovery, for then the saprophytic bacteria begin to outstrip tubercle bacilli and the patient is overwhelmed with septicæmia. So in like manner a recovered case would be more liable to contract the disease again, if exposed, for the very simple reason that his pulmonary lymphatics have been seriously damaged. Then if we expect permanent and prompt results the diagnosis must be made early and if possible the patient should be removed from the dust of cities to pure air to relieve the pulmonary lymphatics and bronchial glands of the extra burden of dealing with dust.

I am firm in the belief that practically all infections are through the lungs and primary infection through the intestinal tract is extremely rare. The reason for this belief is in the fact that undoubtedly all fatal cases swallow more or less sputum from the very first onset of the disease and yet in *post mortem* work the mesenteric infection, if present, is usually recent. This belief is further strengthened in the knowledge that the bronchial glands show such a large percentage of primary infection and this infection could only come from and through the lungs. Granting for the sake of argument that bovine bacilli ingested in milk could cause infection of man, it is more than likely that they would be arrested in the mesenteric and other glands, eventually infecting them. And right here we must ask if tuberculous milk and meat be the sources of infection to man, where then does the cow get her infection?

Even if they pass into the thoracic duct they would have to pass through the heart and be screened out of the blood-vessels in the lung; and the infection cannot be as Latham thinks it is, for he says that bacilli reach the bronchial glands from the intestinal mucous membrane through the lymphatics, and against the supposed lymph stream. One fails to follow the anatomy of this arrangement, for the bronchial glands are really not close nor are they contiguous to the duct. That the lymph current is reversed is incorrect, for the histology of the gland is that the lymph afferents break up into minute ramifications on entering a gland proper and the efferents arise in or coalesce with these minute ramifications. In any event the current cannot be reversed beyond the first lymph gland. However, a diseased gland of a chain may cause the lymph fluid to back up to the next gland above and so on.

The details of this paper naturally lead one's mind into the field of speculation and I cannot resist summing up some of the more noticeable points as follows:—

Tubercle bacilli possessing specificity for one animal may be harmless in the bodies of another species under normal conditions.

Tubercle bacilli may, and probably do, enter our blood and lymph circulation more or less constantly. This must be true if the contagium is so widely and universally disseminated as Quimby believes. It is doubtful if tubercle bacilli grow and multiply readily in any constantly moving body fluid.

Tubercle bacilli are probably not saprophytic even to the extent of multiplying in the constantly shifting mucus of the air vesicles and bronchial tubes and it is more than likely that tubercle bacilli with an established specificity, do not revert to the saprophytic form and they could not be disseminated and universally distributed in great numbers, as they seem to be, and survive for any long period of time.

One must not overlook the cultural peculiarities of the bacillus suggesting its close relationship to the pathogenic ray fungi which are in all probability true facultative grass parasites.

That apparently harmless plant life may become pathogenic under certain changed environment conditions there is no doubt, since the discovery of the pathogenicity of the yeast fungi.

Primary infection of the mesenteric glands is very rare in adults even when they constantly swallow sputum, and the clinical experience of surgeons is that primary infections of the lymph glands of the neck is rarely followed by secondary infection of the lungs.

Finding cases of tuberculosis here and there in remote country places without possibility of tracing the source of infection is very puzzling.

Several experimenters have been able to modify the specificity of different organisms by implanting them in collodion sacs into various animals.

That lung tissue is frequently infected by means of bacilli gaining entrance through the tonsils, the nasal mucous membrane, or kissing, or the introduction of bacilli in food or drink is doubtful and even if the bacilli entered the circulation from these points we would still have them screened out in the lungs and devoured, if in small numbers, by the bronchial glands

and it would take large and continued dosage to cause fatal pulmonary tuberculosis.

And while no one can believe more implicitly in the danger from dried sputum than I do, for without question, it is the source of a very great deal of infection (if not of all), yet if in this connection we take up the study of the different species of tubercle bacilli, all of which bear such close relationship to one another, we can scarcely keep our minds from wandering from the well-beaten paths of positive knowledge about them; and in spite of one's reluctance to depart from well-established principles it is nevertheless hard to keep from drifting out upon a sea of speculation to the possibility that after all the infection from dried sputum may only be a serious incident—one of the links—the grass bacilli when constantly introduced into the proper medium being the other parts of the chain.

REMARKS ON INTRA-THORACIC PRESSURE; ALSO THE ILLUSTRATION OF THE AUTHOR'S METHOD OF LUNG IMMOBILISATION.

BY CHARLES DENISON, A.M., M.D.

DENVER, COLO.

THE reciprocal relation between the air which flows in the pulmonary spaces and the blood which courses through the vessels within the thorax, is a matter worthy of special study. There is no doubt about this reciprocal relation, for both the air and blood are always coincidently influenced by the varying pressure states which accompany muscular exertion, vocalisation and breathing. If the conditions are such that one of these fluids is embarrassed in its free movement the supplemental pressure goes to the other fluid, which is correspondingly quickened in its action.

If the tissue resistance to pressure is increased on one side of the chest, through abnormal processes as in fibrosis, the more flexible of these fluids, *i.e.*, the air, will first respond to the demand for expansion and on the other side, because of the less resistance there. The interdependence of respiration and blood circulation—the heart and the lungs—in health and disease, is thus apparent.

It is not, however, my present purpose to try to show why the face and periphery of the body generally are congested in hill climbing, or how the same parts are blanched in chill, or heart failure; any more than it is to seek to fathom the blushing of the heart-throbbing maiden or the paling of the frightened criminal.

But it is my purpose to call attention to some of the air-pressure states which characterise various diseased conditions of the lungs and pleura, and to try to differentiate the indications for treatments necessarily as various as the diseases. For, between the truism that the life of the lung is its use, and the other truism that to cure a diseased organ you should, if possible, put it to rest, there is a broad field in which there is a better choice than either "horn of the dilemma." We must recognise the difference between an acute febrile toxæmic congestion (bordering upon strangulation of a part, necrosis or suppuration), and a chronic febrile induration, with catarrh or even pulmonary excavation, but with tolerance and elimination already in a great measure established. Where between these two extremes, wherein the great majority of invalids at health resorts are to be found, will you take your stand as to the interdiction of muscular exercise, high altitudes and pulmonary gymnastics? Our great fault is the failure to recognise in this discussion of the desirability of exercise, the many characteristics of a case of disease as well as its environment. No one should take a decided stand without stating the kind of case he refers to, and unqualified opinions are necessarily of questionable value.

The misunderstanding between opposing disputants is, undoubtedly, largely due to not limiting the harmfulness of exercise to severe or very febrile cases. The line of differentiation may be questionable, but, nevertheless, the general argument has of late been a too wholesale condemnation of exercise. I wish to show that the more we can imitate Nature's method in our curative efforts, the nearer we shall be on the right track. Nature's method of cure in chronic pulmonary disease involves not only the contraction and scarring over of diseased areas, but the coincident compensative distension of surrounding healthy or less affected portions. The expansion of the air, because of its changed temperature when inhaled, as in cold climates, takes place in the direction of the least resistance.

Dr. C. Theodore Williams instanced the very general result

of vesicular emphysema adjacent to healed lesions, in cases of pulmonary tuberculosis arrested or cured in high altitudes. Despite the varying changes of pressure states within the lung here is the healing by contraction, and no meddlesome injection of nitrous oxide gas into the pleural cavity either.

Those of us who hail from high altitude resorts have seen hundreds of persons recover while living an active life there. This is because of the contraction, Nature's natural shrinkage of the affected lung, while the other lung shows ample compensation for this deprivation. In a case I have in mind, there remains, several years after arrest of tubercular disease of the right lung, only a one-half inch movement of that side, while the other, the left side, has acquired an expansion of three inches.

The views in contravention of the exercise and altitude treatment found, at the last meeting of the American Medical Association, such a pronounced champion in our fellow member, Dr. Norman Bridge, through his paper on "The Proper Management of the Tuberculous Lung," that I cannot do better than take his points of argument for our discussion.

That part of his article which seems to invite discussion is the do-nothing policy advocated.

He says: "It is unwise and unfair to tax a consumptive with the duty of watching the manner of his breathing. To be quiet and protect others from his expectoration is about all we ought to ask him to do."

Since when has it been wrong for the physician not only to determine the causative relations to tuberculosis of defective and insufficient breathing habits, but also to do his best toward correcting these faults through instruction of the patient and urging the systematic practice of appropriate breathing exercises? Is it not rather the physician's bounden duty to determine if he can, the errors of respiration and, at the earliest practicable moment, to set in motion the remedial measures which will counteract the evil? Indeed, the improvement in

recoverable patients seems to bear a very close relation to their knowledge and ability to breathe properly, and to live that kind of out-door life which stimulates healthful respiration.

Let us analyse the author's objection to the use of a tuberculous lung. He says "shallow breathing is important and beneficial for a tuberculous lung that has to breathe, better than that, is no breathing. The good rule to put a sick organ at rest finds no exception here, quiescence gives the forces of Nature the best chance."

I recognise no ground for such argument except it be limited to a lung in active inflammation at the time of hæmorrhage, or rapidly breaking down. I fail to find any such limitation in this paper. The initiatory and infiltration stages are presumably included. One has to object to this, though one admits, as I do, the reasons given and necessity for chest immobilisation in advanced or special conditions.

I heartily agree with his premise that "quiescence of the lung favours the limitation of the disease by fibrosis around and within the part involved with the smallest amount of fibrous tissue, and the smallest amount that can be effective is desirable." Sometimes (and in unfavourable atmospheres) it is true, that "deep breathing does violence to the fresh, new fibrous tissues and so probably stimulates the further and excessive growth of it."

But the life and healthfulness of a lung depends upon its use, and the curtailment of its natural function in any part should be looked upon as a compromise, supplemented if possible, by an equivalent use of unaffected portions. The chief consideration for chest immobilisation, then, is that it can be unilaterally applied, and that the other lung can do the supplementary work thereby required by it. If both lungs are chronically affected, or nearly so, we are correspondingly handicapped, but, even then, I think so much of the method of unilateral chest immobilisation (described later) that I would use it in localised hæmorrhagic infarction, pleurisy, and in excessive

softening. In pulmonary hæmorrhages I have found it of signal service, also in steadying and stiffening the thorax in fracture of the ribs. In the effort to limit cavity formation it has been quite as useful in performing its chief function, which is to limit fibrosis to the region needing it and to the extent necessary.

But this benefit and the stated reasons for it, give no ground for the statement "There is no particular need of or significance in the popular efforts in the real or supposed expansion of the chest by deep breathing and wide movements of the arms," which the author claims are ineffective to "ever expand the chest any way, since the shoulders glide over muscular masses around the cone of the chest without changing its diameter or its position. That they can so act is a layman's theory," he says, "founded in poor knowledge of anatomy."

Indeed, we are surprised that a non-recognisation of the important relation of the anatomical structure of the thorax to arm movements and chest exercises should be laid *alone* at the door of the "layman." We physicians should more generally recognise the relation of the pectoralis minor and major, the latissimus dorsi and the intercostal muscles to respiration, and the normal function of respiration, its limits and conditions, so that we may consistently and steadily try to bring back the diseased lung to its normal state.

After thirty years of practice under conditions calculated to enable one to form a fair judgment, the hobby of "rest" for the lungs appears to me to be very generally over-ridden. Numerous articles advocating the do-nothing policy go unrebuked because it is all right for a doctor, not knowing anything better to do, to hedge against over-action. He ought to know when and how far exercise is admissible, and the great and inestimable value of systematic progression of both breathing and chest exercise. Substitute walking, massage, &c., if you like, but adjusted and proportioned pulmonary gymnastics constitute, up to a certain point, one of our best aids in the arrest

of tuberculosis. A personal knowledge of each individual case should determine the degree of exercise which is advisable or permissible.

In harmony with such extreme views, this essayist has something to say against altitude. To quote: "Altitudes do not help the sick with lung tuberculosis by expanding to a greater degree the air vesicles. The theory is fallacious, unphysiologic and wrong. The benefits of altitude must be explained on the theory of the increased number of red blood corpuscles, even if they are reduced in size, and of attendant and other advantages to the general nutrition of the body. These advantages are not discounted when we try to explain them on the natural ground of known physiologic changes, instead of upon suppositious grounds which are founded in error."

This is indeed ingenious, but how lacking in proof. For instance, is it correct or logical to admit the increase in number of the red blood corpuscles and "other advantages to the general nutrition of the body," and at the same time to deny their relation to the increased amount of air consumed and the consequent necessarily greater expanding of the air vesicles? One may admit that there is an increased amount of static electricity in the altitudes and an easier conversion there of oxygen into ozone, either within or without the blood. That, however, does not controvert the established law that the amount of air used is proportioned to the lessened barometric pressure of the given altitude. No, it is unreasonable and illogical to try to dissociate the complex effects of lessened atmospheric pressure (especially including the greater distension of the air cells due to the greater amount of air used) from those "known physiologic changes" which every observer properly attributes to altitude. Similar physiologic changes are produced, though not in the same degree, by those exercises and methods of breathing which *do* produce distension and uniform use of the air vesicles, showing that all these aids to healthful pulmonary

activity are inseparable and support each other as conditions of the cure. Of course, altitude and exercise intensify the influence of each other. However, the wholesale combating of exercise is strained when it is made to include opposition to the altitude. This is proved by the fact that when quiet, sitting or lying, even an invalid's respiration and pulse are not much accelerated a mile above the sea. There is ordinarily more difference between sitting still and walking at the rate of two miles an hour at sea level, than there is between lying down at the sea level and at ten thousand feet elevation.

The opposition to a successful and beneficial method of breathing for the consumptive—exhalation sustained against pressure—is equally groundless (for curable cases) with that to altitude and exercise. Quoting again: "Breathing through diminutive contrivances of tubes with large inlet and smaller outlet, so as to produce increased pressure within the chest to expand the air vesicles is harmful if any effect at all is produced." Has the author ever measured the results of such exercise, long and systematically practised, and judged of them by the spirometer and manometer records before and afterwards? He does not appear to appreciate the influence upon the blood circulation which is produced by the increased pressure within the thorax, in the method above referred to, forcing onward and outward to the periphery the sluggish currents within the lungs. Nor does he appear to appreciate the concurrent even and general distension of the air cells, which to a degree can be borne with comfort by the weakest invalid. In fact, there is a persuasiveness in the mild stimulation of previously unused air-cells which makes this method of pulmonary gymnastics usable by patients who are too weak to take other physical exercise. As to any harm resulting, I have employed the method in hundreds of cases and know that that is impossible if discretion and reason are applied in its use.

The opinion expressed by Dr. Briggs and others in regard to pulmonary exercise must of necessity arouse opposition on

the part of those of the profession whose experience in the treatment of pulmonary diseases in high altitudes does not corroborate the arguments of these opponents to exercise. The "pity" is on their side and not on ours. Think of the lives that are lost or frittered away in the crowded cities of the east, when an active life out in the country or up on our western plains, reasonably undertaken, would assure an arrest of the disease. Is it not to be feared that the medical profession is coming to be "a party to the crime" in harbouring the disease in its original haunts, by keeping tubercular patients in closed sanatoriums or hospitals. If this must be done, let the ways of Dr. Walther's institution in the Black Forest in Germany be followed. Going through the main building of this institution last summer, I saw no confinement of the sick to inaction indoors. They were all out on the hill side or up the narrow canon presumably active according to their condition and ability. When they did return to their rooms, it was to the equivalent of an out-door life, for the window sashes were removed from the whole building.

I heartily agree with the contention that public speakers with pulmonary tuberculosis should quit that vocation. Some of my most unsatisfactory patients have been preachers with laryngeal complication. Perhaps the forcing of the air outwards, to assist a weak vocalisation, has something to do with the greater lung shrinkage and increased fibrosis which characterise these cases. A reason can be seen in their experience for some different and opposite kind of pulmonary gymnastics than that which their profession induces, *i.e.*, that kind which would distend the air vesicles.

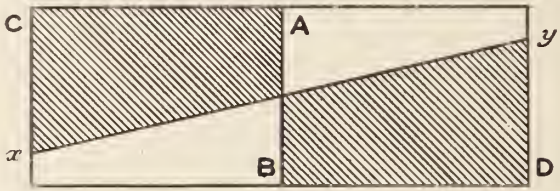
Now as to immobilisation of the diseased lung, when needed, I do not endorse the author's conclusion that "gas inflation of the pleural cavity, according to the method of Murphy, is undoubtedly the best way to accomplish this purpose when it can be done." There are apt to be too many concealed hindrances to its success, especially bilateral extension of disease

and adhesions of the affected side. The four cases I have had under observation in Colorado, on whom this operation had been previously tried, were left in an unfortunate state because of adhesions, extensive fibrosis and shrinkage of the affected lung. Two of them remained in a mental state of bitter opposition to the operation.

The substitute method described by Dr. Briggs, of strapping the chest is, I think, too cumbersome and indefinite in sustained effect, the plasters, as admitted, having "a tendency to creep or slide."

I will give the method of strapping the chest I have employed for years, as simplified up to date. We can obviate the special spreading of traction adhesive plasters, formerly deemed necessary* by the following use of the moleskin adhesive strips, as manufactured in 7-inch wide pieces. For a small person 1½ feet will answer, and for a very large chest 2 feet or more of the 10-inch width would be preferable.

First, without removing the protecting muslin from the adhesive side, cut through the centre lengthwise, diagonally as shown in the drawing (*x* to *y*), the small ends left being about 2 inches wide.



Then strip back and remove the muslin from A to C and B to D. The application is made by lapping the adhesive ends A and C over each other in the infra-axillary space of the side of the chest to be immobilised, the small ends extending

* *Transactions Colorado Medical Society*, 1898-99, "Traction Plasters for Temporarily Contracting the Affected Lung, in Lieu of the Murphy Operation"; and *International Journal of Surgery*, July, 1899, "Air Limitations to Intra-thoracic Surgery."

diagonally upwards, front and back, to the point of the opposite shoulder. A collar, for a fulcrum, is made to fit over this shoulder, say out of cheese cloth in which a little cotton is rolled, or of Canton flannel with fuzzy side outward. Now with safety pins you can cinch up the non-sticking ends of the plasters to the collar so as to make a harness which will stay just where you put it, and as tight as the patient can comfortably bear it. In fact, you can obtain practically complete rest to that lung, the movement of that side of the thorax being *nil*, and that of the diaphragm and mediastinum being minimised to very little. I have left on these traction plasters for two weeks. Where necessary to keep up the effect, I have either applied new ones, or had a canvas jacket made on similar principles —with fulcrum collar and diagonal straps, and with lacings or buckles in front. Where the attending physician fears to trust a too ambitious and reckless patient, as after a hæmorrhage or abscess, this strapping of the chest gives the needed immobilisation, and is very satisfactory both to doctor and patient.

In previous papers the arrest of pulmonary hæmorrhage (properly located), the contraction of pulmonary excavations and the relief of pleurisy have claimed attention. In closing this paper an instance of where the limiting and fixing of fibrosis seemed to demonstrate the utility of this method will be given.

A young attorney, aged 31, from Chicago, came to Colorado in April, 1900, having had right pleurisy two years previously. This was undoubtedly tubercular, for on physical examination an excavation was found in the apex of his right lung, and the previous August he had had a hæmorrhage from near the same pleuritic spot in the lower right mammary region. From April to the end of December the case was only slightly improving. Then he responded so well to the tuberculin test that treatment with the watery extract was instituted and kept up until February 22 following. There was some contraction of the right cavity and evident healing of the affected portion in right infra-mammary. A gain of 19 lbs. in weight during

the previous winter and general good feeling led the patient to decide to return to Chicago, March 22, 1901. This was for family and business reasons and against my advice. Health was good until August, when, having taken a bad cold, coughing seemed to break open the spot in base of right lung, for, with the resulting profuse hæmorrhages, scar tissue was expectorated and a small excavation left there. He remained in a weak condition, fearful of more bleeding if he did anything or tried to come back to Colorado. After being quiet or housed several weeks he came back to Denver the middle of October. His gait was slow and he was bent over to the right, to favour the affected spot. It was at once clear to me that strapping with the traction plasters would give courage, needed support and limit healing fibrosis to the right degree. This was done and the application was most successful. Improvement was satisfactory in every way. The plasters were worn two weeks.

A similar experience this last April, due to this patient's self-inflicted confinement and overwork at his desk, led again to the strapping of the chest, by which it is hoped an increase in the size of his excavation has been limited.

DISCUSSION.

Dr. OTIS: Regarding the favourable effects obtained by Dr. Denison in pulmonary hæmorrhage by his method of chest compression, I would like to ask him in exactly what way he considers these effects are produced. It would not appear to be possible to produce sufficient mechanical pressure by strapping the chest to influence a hæmorrhage going on inside of the lungs.

Further, it is difficult for me to believe that any strapping of the chest such as has been demonstrated to us, can produce immobilisation of the lungs to any extended degree. One can, to be sure, restrict to a greater or less extent the excursion of intercostals and other accessory muscles of respiration—a very useful procedure in the pain of acute pleurisy—but that great muscle of respiration, the diaphragm, surely cannot be influenced by the method advocated. When you compress the lung by an artificial pneumothorax, as by the Murphy method for example, then you act directly upon a compressible substance ; far different is it, however, when you make the attempt by strapping the bony framework of the chest. I therefore

cannot comprehend how any especial favourable effect is produced in a case of pulmonary tuberculosis by such external restriction of the chest.

Dr. ALBERT ABRAMS, of San Francisco (by invitation): Two questions suggest themselves for discussion in the paper of Dr. Denison. The first is the *rationale* of lung immobilisation, and second, the completeness of the method advised. During recent years, the tendency of therapeutists is to seek for lung quiesence in pulmonary affections. No doubt this tendency has been inspired by the antagonism which has been known to exist between chronic valvular lesions of the heart and pulmonary tuberculosis, the one exception being stenosis of the pulmonary orifice.

The method of Murphy by intrapleural gas insufflation was no doubt suggested by the method of Bier, which sought to induce venous hyperæmia which has been so successful in the treatment of joint affections. The inhalation of carbonic acid was another evidence of this hypothesis. Still later, Robin, in the Paris Academy of Medicine, sought to show that our conception of pulmonary tuberculosis was erroneous, that in fact, an excess of oxygen was taken into the lungs, and that in lieu of a sub-oxydation there was really a hyper-oxydation existing in pulmonary tuberculosis. The tendency to secure lung immobilisation in pulmonary tuberculosis is wholly at variance with our modern methods of open-air treatment. Careful observation shows that the latter is the only recognised method of treatment. Otherwise, we would have to resort to asphyxiation of our patients, nstead of securing aseptic drainage of the bronchial tree.

Relative to the treatment of hæmoptysis, investigations show that lung immobilisation is by no means as efficient, in many instances, as long, deep breaths. In fact, many of us who employ the compressed air of the pneumatic cabinet find that hæmoptysis is often arrested by such inhalation, for the tendency is to exsanguinate the lungs. In pleurisy, strapping the chest will no doubt greatly relieve pain and inhibit pleuro-genic coughs, for by this method we are but imitating Nature. I have often observed patients under the X-rays suffering from the pains of pleuritis who showed immobilisation of the diaphragm, whereas, when the intercostal muscles were palpated they were extremely rigid, Nature's tendency as it were to splint the lung.

The second question relates to the correctness of the method suggested. Dr. Denison's method seeks only to eliminate the costal type of breathing. I have used different methods of strapping the chest and studied the efficacy of such methods by aid of the rays. I found, that when costal breathing is eliminated diaphragmatic breathing is compensatorily augmented, and furthermore, that the apex of the lung corresponding to the side of the chest strapped is increased almost twice in area, a condition which I have termed "Apical Ballooning." Now as the majority of cases of pulmonary hæmorrhage have their origin in the lung apices, you can readily see how strapping of the chest would only tend to increase the existing trouble. The ideal method of chest immobilisation must not only take the costal muscles into consideration, but the movements of the diaphragm must be impeded by a strip of a piece of plaster carried below the margin of the ribs.

THE CLIMATE OF THE EASTERN FOOTHILLS OF SOUTHERN CALIFORNIA.

BY DR. C. A. SANBORN.

REDLANDS, CALIFORNIA.

JUST where the dividing line between the eastern and western foothills may be I know not. We will, however, choose to draw an imaginary line, beginning at the mouth of Cajon Pass and encircling the east San Bernardino valley, taking in Riverside just across the divide, the city of San Bernardino, Highlands, Redlands, and Colton, to the mouth of San Timateo Canon. Extending this line east we reach Beaumont, Banning, Palm Springs and Indio. Except for the coast climate we have every variety, from that on the desert, below sea-level, to any altitude up to 10,000 feet.

When I asked one whom we consider authority on climate, what he thought of Southern California, he answered, "What has been said of Florida is true of Southern California." It seems to me that this is too much the idea of many, and it is erroneous.

On May 1, a physician in San Francisco wrote to know if his patient could longer endure the heat in the south, and whether he had not better request him to return home. A physician in Pittsburg thinks a longer stay for his patient "will undo all the good which the winter months have brought about."

The fact is, there are few days in the whole year too warm to enjoy and thrive in in this section. It is said there are 320 days of sunshine in the year, the other forty-five covering

all weather disagreeable from rain, wind and heat. We do not mention cold, for while it is cool and bracing through the winter months, the thermometer seldom goes below 32° F. During my fifteen years' residence and experience in orange growing in Redlands, I have never found frozen fruit in my orchard, although ice often forms to the thickness of a third of an inch. The explanation of this fact is probably due to the currents of air, and to the fact that the cold is of short duration in early morning—the coldest time being just before sunrise.

What I may say of Redlands, which I choose as the centre of the region to which I desire to call attention, is in a measure true of all the towns in this end of the valley, climatic conditions varying somewhat with altitude and exposure. The average altitude of Redlands is 1,200 feet, the valley at this point being about six miles wide. On the north, standing like giant sentinels, and at present snow-capped, are the peaks of the San Bernardino Range, having altitudes of from 3,000 to 11,500 feet, the ventilation being through canons opening on to the Mojave and Colorado deserts. These mountains form a three-quarters circle, the range on the north extending to the sea, that on the south breaking into irregular and isolated low peaks which trend, toward the south, to Riverside and beyond, while on the other side of this gap, low peaks form an uninterrupted chain toward the sea. Between the high mountains on the north and the low ones on the south come, during the summer, our trade winds, rushing into the vacuum caused by the intense heat on the desert during the day, returned over mountains sufficiently high to cool the nights. Thus the majority of days are rendered cool during the summer months, and the nights almost invariably so.

The average temperature for the past three years, of the four months exhibiting the greatest extremes of heat and cold, is as follows:—

January.	Mean maximum temperature	62 degrees.
	Mean minimum temperature	40 „
	Mean relative humidity...	55 per cent.
February.	Mean maximum temperature	about 69 degrees.
	Mean minimum temperature	42 „
	Mean relative humidity...	60 per cent.
July.	Mean maximum temperature	about 95 degrees.
	Mean minimum temperature	59 „
	Mean relative humidity...	53 per cent.
August.	Mean maximum temperature	about 91 degrees.
	Mean minimum temperature	58 „
	Mean relative humidity...	55 per cent.

I dare say many of you are expecting me to recommend the climate of the Eastern Foothills as one especially adapted for tuberculous troubles. Patients with pulmonary lesion, not far advanced, do well in this climate, especially in that part of the valley where orange growing and the consequent dampness from irrigation do not prevail. Just here I should mention the irritation to the respiratory tract brought about by the extensive use of commercial fertilisers. A prevalence of tonsillitis and pharingitis among old and young has been quite noticeable, occurring at the time of the spreading of this necessary adjunct to the production of our citrus fruits.

Physicians must not expect that climate and climate alone can bring back to health patients having tubercular lesions. An out-of-door life, however, in this nearly perfect climate may, in some instances, revolutionise a patient's physical condition. With climate there must be conditions to promote contentment. Some slight occupation, as soon as strength permits, should be taken up. The patient with means has the advantage over one who is less fortunate in this world's goods, as he can have the supervision of an orange ranch, or some equally pleasant and profitable occupation. I cannot emphasise too strongly the necessity of contentment of mind for the health-seeker. This can be accomplished only by employment.

I am often asked what causes the nervous troubles which are prone to prevail in Southern California. There are many

factors entering into the causation of this increasing tendency of both sexes toward nervousness. North winds and altitude are not alone responsible for these conditions. Continued eye-strain, from a succession of bright days without proper protection for the eyes, causing headaches, predisposes not only invalids, but healthy persons to nerve exhaustion. But nostalgia is probably the most important factor. However much the sun's rays may irritate the eyes and burn the skin, they do not relax the nervous system as much as the sultry summer atmosphere of the East.

It is not my purpose to defend our climate, or to apologise for its drawbacks. All things considered, we have here in these eastern foothills as nearly a perfect climate as can be found anywhere.

As Southern California grows, conditions for recreation and contentment multiply, and it is my firm belief that in the near future nervous troubles will be less and less prevalent.

With such a climate, and with the class of people who are coming here to make their homes, we ought to produce the ideal race, mentally, morally, and physically.

Every detail for the best physical and mental development of the child should be carefully looked after. There should be proper food, proper clothing, and a school year regulated with some regard to climatic conditions. As the child is father of the man, so our children, offspring as many of them are, of semi-invalid parents, should be carefully nurtured, and all hygienic measures faithfully pursued.

SOUTHERN CALIFORNIA FOOT HILLS.

BY DR. GEORGE E. ABBOTT.

PASADENA, CALIFORNIA.

MR. PRESIDENT AND FELLOWS OF THE AMERICAN CLIMATOLOGICAL ASSOCIATION,—It seems to be the inalienable right of a climatologist to inhale his native climate and exhale the same in a syllabic chain, more or less at variance with the thoughts and observations of his fellows in other climates, but almost always with the approbation of those who dwell near him.

I do not know that I can be so fortunate even as this, for it is not the purpose of this paper to give the results of an exhaustive research into various climates, in comparison with innumerable tables of averages and a half column of bibliography, but rather to have a short chat with you—reduced to writing that more may be said and said more accurately in the twenty minutes allotted to me.

I want you to look at a few of the features of the foot hills of Southern California, with the retinas that I am using after eight years of residence here.

I do not understand that you are on your tour of observation with the intent to settle, yet if so, we extend to you, one and all, a most cordial welcome, for the more thoroughly educated men we have with us the better, but rather that you may the more fully fulfil your duty to patients whom you are called upon to send to a climate different from their own.

What would eastern physicians think of an eastern real

estate broker, who should take from his desk a map of Los Angeles, San Diego, or Pasadena, having never been in either place, and advise his client to invest in such and such a square or block, or buy on such a street. This is but a parallel case to the advice often given to many patients, and the results are as often that of bankruptcy in health as of large gains, and it is a pleasure to assist you in any way that may be in our power to give more accurate advice to those whose lives as well as money are placed in the balance.

Others will tell you of the delightfully stimulating effects of high altitude, and of the restful sedative effects of sea-levels. The lot has fallen to me to give you some of the conditions observed in the foot hills of Southern California.

First, it must be remembered that there is a vast difference between the *Foot of the hills*, and *the Foot Hills*.

The foot of the hills always carries with it a back ground of high altitude, with its cold night air, whereas, paradoxical as it may seem, there may not be any hills in the foot hills, but rather large areas of table or mesa lands.

As a rule, however, there are, of course, small hills upon these mesa lands, which lend all the more attractiveness to the well and especially to the invalid. Let us agree then that the foot hill shall comprise an altitude from one to two or three thousand feet elevation.

It must also be remembered that the study of climate by the American Geographical Society is entirely different from that of the American Climatological Society—the Geographical Society studying the effects of climate upon nations or at least upon large communities, whereas I judge, the aim of this Society is to seek the best medical effects to be derived for a given individual or set of individuals afflicted with a given disease, be it hay-fever, tuberculosis, rheumatism, or excessive neurasthenia.

From the various scientific and popular articles upon climate which we read, one would judge that the majority of physicians

and others think that climate depends entirely upon air, at rest or in motion, sunlight, temperature and electricity, clouds, &c., the proximity of mountains and the sea.

It is one of the purposes of this paper to show that it depends, as you all well know, largely upon geology as well. That the earth structure of the patient's residence has very much more to do with his recovery than the latitude and longitude of his dwelling house.

If in one community a majority of the people are constantly chilly, catarrhal, rheumatic and poorly developed, while in another they are as constantly warm, free from catarrh, have no rheumatism and are well developed, I believe we will all admit that, other things being equal, there must be a marked difference in the climate of the two places.

On the banks of the Hudson River, midway between the cold trap-rock region of the Catskillls and the warm sandy areas of New Jersey, is a little town in which there are two houses, just one half mile apart, having the same air, sunshine, temperature, humidity, clouds, electricity, &c., but with an entirely different geological foundation and an entirely different "climate."

The first is situated upon a cold, slaty subsoil. If one sits upon the grass of a summer's evening, he rises in twenty minutes, chilled and stiff. The family are always catarrhal, rheumatic, chilled and half sick.

The other home is located lower down and nearer the river, but on a large, sandy and course gravel bluff. The well had to be dug sixty feet before reaching any water-bearing strata. One may camp all night here, sit on the grass and watch the tennis and croquet, with impunity. The members of the family are always well, free from colds, catarrh and rheumatism. When the first family spends a few days with their cousins, they immediately begin to improve in health.

The pictures I have drawn of these Hudson River homes is largely typical of our high mountains and of our foot hills.

The mountains are, as a rule, cold, rocky regions, and in consequence of mountain fires, they are barren, their canyons barren and deep. Ages since, their lofty peaks, thousands of feet higher than now, were tumbled into the broad valleys, so that at present the dwelling places of our foot hills have a most desirable subsoil of mountain waste from twenty-five to three or four hundred feet deep. This is especially true of the entire area of Pasadena, largely so of Los Angeles, and of the whole foot hill region of San Diego County. Aside from this, the conformation of the foot hills gives perfect surface, as well as subsoil drainage.

This then is the fundamental reason of the desirability of the larger valleys and mesa lands of our foot hills, not merely a small area for one home, but thousands of acres for large communities.

The heart and lungs combine in rejoicing in our foot hills. Many a patient is sent to a high altitude with instructions to lie down and rest, and keep as quiet as possible the first few days, but the poor labouring heart cries out for rest but can find none; it must contract, and rapidly at that. The demand upon it is enormous and continual, but there is no rest except through muscle poisons and drugs; the same is true of the weak disabled lungs.

At the foot hill altitude we escape this excessive heart strain and patients of all classes find a most delightful pleasure in riding and walking over the slight variations found in roads and trails. My belief is that in after years we will send more of our invalids to the foot hills and more of our convalescents to the high altitudes.

There is another feature of our foot hills not found in the Eastern foot hills. It is what is known as the frostless belt. In the deep still valleys we have killing frosts, at times, during the winter. The same is true of some of the high hill tops, but between these points there is a broad frostless belt—all along the hill sides and mesa lands where there are no killing frosts from year to year.

You will observe that I say "no killing frost." Here again is a distinction; we may have hoar frosts and even frosts sufficient to destroy the more tender plants, such as the tomato vines and heliotrope, but not sufficient to destroy our citrus trees or to produce serious colds for our invalids, or the majority of our plants. These frosty nights are only at long intervals even in the winter and are entirely unknown during the majority of the year.

This frostless belt is of great interest to the horticulturist, but what does it mean to the climatologist and his tuberculous patient? I believe that within ten years it will mean the difference between life and death to hundreds of invalids.

The key to health and the watch-word of the future invalid must be "never breathe the same air twice." In this frostless belt one may sleep in the open air at night and exercise with coatless freedom during almost the entire year.

This, then, is what our frostless belt of the foot hills means to the health seeker of Southern California! As to humidity, allow me to quote from Mr. Ford A. Carpenter, of the Weather Bureau of San Diego. He says: "nothing so clearly illustrates the local character of the climate of San Diego as the humidity. While the mean annual relative humidity is 78 per cent. at the weather bureau station, two miles north, and at an increase of 200 feet in elevation, the humidity decreases 15 per cent. Five miles away and at an elevation of 300 feet, there is a further decrease of 5 per cent. The temperature is of course proportionately higher.

"The maximum amount of sunshine occurs in November and the minimum in May and June, the winters being clear and warm and the summers cloudy and cool. A photographic recorder installed in 1890 showed an average of but three days per year without sunshine. What is true of the middle ground of altitude between sea-levels and the high mountains, is also true of fog and cloud. The foot hills largely escape the low chilly fogs creeping in over the surface of the ground. They

quickly lift into scud clouds and float over us high above our heads.

These cloudy days, which occur in May and June, are apt at first to make patients depressed, blue and melancholy, but when they recognise that it is the same kindly hand that made the genial climate, that spreads out the clouds like an immense umbrella over the Southern California hills, to protect man and beast as they toil in the fields, to cut short the heat of the day and prevent the constant evaporation, they become glad at heart.

There is one statement I very much wish to make for the sake of California and those interested in her climate.

Many of the hotel reports advise our Southland as a land of perpetual spring. This is not the case—it is not perpetual spring, with the moist, murky climate of Florida. It is far better. It is perpetual fall—a never ending September and October of New England, a climate clear and bracing, and where it is a joy to live, where one can live for ever in the open air. Even our rainy season is a misnomer. There is no rainy season as one usually undertands the three months of rainy season of the tropics. Our rainy season is merely the season when the rains come. It rains in Southern California just as it snows in New England, and between the shower days there are the brightest and happiest days of all the year.

There is another truth. That notwithstanding our warm, genial winters, our summers are not hot, but almost as cool as our winters, in fact the average Californian enjoys the summers more than the winters. It is the best part of the year, and I can vouch for the fact, after a four years' residence at Coronado Beach that *it* as well as the beaches of Los Angeles region, are much cooler and more delightful than Newport, Narragansett Pier, or any of the Long Island, or New Jersey summer resorts.

We must remember that Southern California is a climatological peninsula, projecting southward, surrounded by a boundless ocean of cold water on the west, and an immense sea of hot sand on the east. Across this strip of country the air

ebbs and flows, the cool sea breezes during the hot days and the warm land breezes during the nights, just reducing them from cold to cool.

Much of interest is to be observed and recorded as to the topographical influence of our high, precipitous mountains hedging in the hot desert sea, while their western hillsides slope gradually to the ocean, giving our foot hills the advantage of the very best attack of the sea breezes, while the hot desert air is held back as by a dam at night.

I can but say that aside from all the other factors that go to make up climate, the patient's mentality is one usually overlooked, and nowhere can one secure such a delightful mental environment as in the foot hills of Southern California. To the convalescent such communities as Los Angeles and San Diego, or even better, Redlands, Riverside and Pasadena are exceptionally agreeable; while to the "shut-in" and bedridden invalids the view from many a piazza and bed-room window of our beautiful valleys and foot hills gives them a never ending and ever varying panorama of beautiful change almost never the same two hours of a day, or two days of the week.

Of all the climates of the earth with which I am acquainted, or of which I can learn, the climate of the foot hills of Southern California is by far the best. However, we urge you not to take our word for it, but to come out and live with us and study and enjoy it for yourselves.

CLIMATOLOGY OF CALIFORNIA.*

BY PROF. ALEX. G. McADIE.
WEATHER BUREAU, SAN FRANCISCO.

THE traveller in Mediterranean waters passing Cerigo wonders if that can really be the far-famed Cythera where Venus rose resplendent from the sea. A sun-baked, wind-worn rock meets his view, and the obvious conclusion is that either great natural changes have taken place since the poets sang or else these ancient writers held not closely to the truth. How frequently is the traveller disappointed because imaginative writers have all too glowingly described some locality. And possibly this holds somewhat in description of California. On the other hand, a bald statement of fact and a table of physical data very inadequately tells the story of a place. Particularly is this likely to be the case where meteorological data are given. The writer has in mind the islands lying in the Pacific about twenty-five miles due west of San Francisco. If tables of mean temperature, daily range, or annual range of temperature, extreme temperatures, &c., be considered only, the Farallones will compare favourably with any portion of California. Yet few of us are willing to dwell upon these islands. If, then, we are to keep meteorological records, by all means let these be as complete and detailed as possible. Dr. Hann has given the following list of climatic factors which should be

* By permission of the Chief of the Weather Bureau; read by Dr. W. F. R. Phillips.

given in the discussion of the climatology of a locality. And it need only be said that full as this list seems to be, it but partly tells the story of the climatology of any place. The different factors are:—

(1) The monthly and annual mean temperature; (2) the mean diurnal range for each month; (3) the mean temperature at two given hours; (4) the extreme limits of the temperature of the months; (5) the monthly and annual extreme temperatures; (6) the absolute highest and lowest temperatures; (7) the mean variability; (8) frost data; (9) insolation or solar radiation; (10) terrestrial radiation; (11) soil temperatures, (12) absolute humidity; (13) relative humidity; (14) total precipitation, rain, snow, fog; (15) maximum precipitation per day and hour; (16) number of rainy days; (17) percentage and probability of rainy days; (18) snow, depth, duration, number of days covering ground; (19) dates of first and last snow; (20) hailstorm frequency; (21) thunderstorm data; (22) cloudiness; (23) fogginess; (24) nights with dew; (25) air movement or wind velocity; (26) frequency of wind direction; (27) pressure data; (28) evaporation data; (29) impurities, number of dust particles, bacteria, &c.; (30) electrical potentials.

To this long list Professor Abbe adds ("Maryland Weather Service," page 266):—

(31) Sensations experienced, *e.g.*, mild, balmy, invigorating, depressing, expressing the integrated effect of the various factors upon the human body; (32) the number of storm centres passing over the locality, *i.e.*, briefly, its storm frequency; (33) frequency of severe local storms; (34) duration of twilight; (35) blueness or haziness of the sky; (36) frequency and degree of sudden changes from warm to cold, or moist to dry.

This makes a formidable list; and in California some of these factors are of but little importance. Others, such as the distinctive features of fog, air drainage, character of soil, and topographical barriers to air movement, are of the utmost importance.

From the health-seekers' standpoint, honest, unvarnished descriptions of the northers of the great valleys, the Santa Anas

FIG. 1.—RELIEF MAP OF CALIFORNIA.

of the south, and the trying west winds of the bay section, are essential.

In discussing the climatology of California, two broad propositions appear: (1) air motion; (2) air purity. To these add all that can be determined concerning the amount and behaviour of the water vapour; for when all is said and done, it is this factor, this most protean of the elements, which determines our comfort. It exists independently of the air, and we know it as rain, snow, hail, frost, dew, fog, or cloud, from the lowest stratus to the highest cirrus. If we live below it, as we too frequently do, it will determine the range of temperature, the frequency of change, or the equability; the amount of sunshine, for it is the veil between us and the sun; the cloudiness, the rainfall, and even the relative purity of the atmosphere. Our atmosphere is composed of oxygen, nitrogen, carbondioxide, argon, krypton, helium, neon, zenon, and vapour of water. But first and foremost in determining climate is water vapour.

California faces the ocean. Small wonder, then, that along the coast and wherever there is an open thoroughfare for the winds from the sea the temperatures are nearly constant. The coast-line of nearly a thousand miles shows a difference of but 5° C., or 10° F., in the mean annual temperatures of its northern and southern limits. At Eureka the temperature is 11° C. (51° F.); at San Francisco 13° C. (56° F.); and at San Diego 16° C. (61° F.). If we compare these figures with those of three points on the Atlantic sea-board practically corresponding in latitude, we find that New York has a mean temperature of 11° C. (52° F.); Washington 13° C. (55° F.); and Savannah 19° C. (67° F.). In tabular form the difference between the two sea-boards may show as follows:—

Pacific Coast ...	16°—11° C. = 5° C. 61°—51° F. = 10° F.	or 1° F. variation for every 80 miles.
Atlantic Coast...	19°—11° C. = 8° C. 67°—52° F. = 15° F.	" " " 53 "

But as we intimated above, mean temperatures do not tell the whole story. To test the relative equability of temperature compare these figures:—

	Eureka.		San Francisco.		San Diego.	
January	8° C.	47° F.	10° C.	50° F.	12° C.	54° F.
July	13° C.	56° F.	15° C.	59° F.	19° C.	67° F.
Range	5° C.	9° F.	5° C.	9° F.	7° C.	13° F.

	New York.		Washington.		Savannah.	
January	1° C.	31° F.	1° C.	34° F.	11° C.	52° F.
July	23° C.	74° F.	25° C.	77° F.	28° C.	82° F.
Range	24° C.	43° F.	24° C.	43° F.	17° C.	30° F.

Here there is a marked difference, and if the physician desires for the patient a climate not subject to large temperature variations, eliminating, as it were, the extremes of summer and winter, the Pacific sea-board offers decided advantages.

In January, as you go south on the Atlantic side, it becomes 1° warmer for every 40 miles. On the Pacific side, as you go south in January, it gets 1° warmer for each 115 miles. Decided changes in temperature, however, can be obtained by travelling either east or west a few miles; and also owing to the peculiar topography of the State and the marked changes in elevation, can be accomplished at many points within an hour or two. Before we leave the matter of monthly mean temperatures a reference should be made to the isotherms of January, as compared with those of July. These are shown on the accompanying maps. The same general north and south trend of the isotherms may be noticed in both maps; but the July map makes it plain that high temperatures are experienced generally throughout the State in summer months, except along the coast. In brief, these maps show that the so-called winter months in California are the really pleasant months of the year.

Note that the isotherm of 40° in January extends well over the central and northern portion of the State, while in July the isotherm of 80° traverses the northern as well as the southern portion of the State. During the summer months one has only to move inland from the coast a distance of less than an hundred miles to experience mean temperatures 30° or 40° higher than the coast temperatures.

FIG. 2.—JULY, 1901. MONTHLY MEAN TEMPERATURE.

Even more remarkable than the temperature distribution is the rainfall of California. In no other portion of the United States are the rainfall periods so differentiated. There are two well-marked seasons, the dry and the wet; the former covering the months of May, June, July, August, and September, and the latter the rest of the year. The mean annual rainfalls vary

from 1 inch to 75 inches. There are places in the south-eastern portion of the State where the total rainfall for a period of twenty-five years will hardly amount to 2 inches. And not infrequently a year may pass at these points without an amount of rain exceeding 0·01 of an inch. In the northern portion of the State the rainfall is very heavy. In some of the

FIG. 3.—JANUARY, 1902. MONTHLY MEAN TEMPERATURE.

northern coast counties, and also in the mountains to the east and south-east of Shasta, rainfalls averaging over 80 inches in a year have been recorded. In years of very heavy rainfall at some of these points more than 100 inches have fallen. The following are some single year rainfalls: Laporte, 120 inches, 1896; 101 inches, 1898. Delta, 111 inches, 1899. Upper Mattole, 102 inches, 1896. In the central and northern por-

tions of the State and in the mountains of the south snow is not infrequent. At Summit an annual snowfall of 697 inches has been recorded.

Little rainfall, then, is expected during the summer months, but if during the wet season the rainfall is deficient the various interests of the State suffer materially. And this question of

Fig. 4.—Rainfall, January, 1902. A Dry Winter Month.

whether the rainfall during a given season will be deficient is probably the most important one with which the climatologist has to deal. An interesting illustration of this variation in the seasonal rainfall is given by the isohyetals for January and February, 1902. The month of December, 1901, had been exceptionally dry. The month of January continuing dry, the outlook was disheartening, and while the invalid might enjoy

life out-of-doors, the business man and the farmer were worrying themselves sick. The excessive rainfall for February, 1902, saved the entire community from great losses, and restored, as if by magic, confidence and courage.

Another point that is plainly brought out by these rainfall maps is the variability both of the rain intensity and the rain

Fig. 5.—Rainfall, February, 1902. A Wet Winter Month.

frequency. During the month of January, ordinarily the month of greatest rain frequency in California, there were but thirteen rainy days; while the next month rain fell on practically every day of the month. The number of rainy days is probably the factor most frequently asked for by physicians in determining the climatic character of a place, a rainy day being defined as one on which 0·01 of an inch of rain or more falls. And yet

there are few conditions more misleading in helping us to form a true estimate of the climatology of a place than the so-called number of rainy days. There should always be furnished, in addition to the number of rainy days, some statement as to the general character of the precipitation itself; for example, whether the rain falls in showers with intermittent sunshine, or whether the rains are continuous and the sky is overcast.

The wind system of California is, like the rainfall and the temperature, characteristically different from the wind systems of other portions of the United States. Here, again, the topography plays an important part in modifying the circulation of the lower strata of the atmosphere. In the coast and bay section there is a well-marked draught through the Golden Gate and into the great valley. Particularly noticeable is this motion on summer afternoons, and many of the fog phenomena so remarkable on this coast may be explained in connection with these strong westerly winds. There is also a well-marked movement of the air from the north thermodynamically warmer in the summer months by its passage over the mountains, and giving rise to the very disagreeable northers of the great valleys; and the Santa Anas of the south.

With regard to sunshine, except along the immediate coast, few portions of the United States can equal California. Over more than half of the State the normal annual sunshine exceeds 75 per cent. of the possible sunshine. Along the coast this is reduced to 50 per cent.

Both in the matter of air motion and in the matter of air purity California enjoys great advantages.

To sum up, then, the general climatic factors of this land of sunshine and of fog, of heavy rainfall and of scant rainfall, this land of contrast, California, we note first, that because of its proximity to the ocean, a great natural conservator of heat, the temperatures are, as a rule, moderate and equable; second, that because of the exceedingly diversified topography the climatic

conditions are likewise very diversified; third, that the prevailing easterly drift of the air brings a constant supply of fresh air, neither too hot nor too cold, to most of the State; and fourth, that owing to the general path of storm movements lying farther to the north, California escapes many of the disturbances so familiar elsewhere. All these combine to give a climate different from other sections of our great country. The effect of the climatic environment is well shown in the flora of the State. What influence the climate will exert on man, and what the ultimate record will be, is for other pens than ours.

THE MOUNTAINS OF SOUTHERN CALIFORNIA.

BY WALTER LINDLEY, M.D.
LOS ANGELES.

JOHN MUIR, who writes so delightfully of our mountains in his two works, "The Mountains of California" and "Our National Parks," justly says: "The influence of pure Nature seem to be so little known as yet that it is generally supposed that complete pleasure, permeating one's very flesh and bones, unfits the student for scientific pursuits in which cool judgment and observation are required, but the effect is just the opposite. Instead of producing a dissipated condition, the mind is fertilised, stimulated and developed like a sun-fed plant." And again our mountain devotee says: "Thousands of tired, nerve-shaken, over-civilised people are beginning to find out that going to the mountains is going home; that wildness is a necessity; and that mountain parks and reservations are useful, not only as fountains of timber and irrigation rivers, but as fountains of life."

It is not my intention in this brief paper to take up the subject, "The Mountains of Southern California," in any exhaustive manner, but simply to call attention to them and to the possibility of profitable study and observation.

The mountains to which I shall call your attention are those in the central part of Southern California. Three ranges known as the Sierra Madre, the San Bernardino, and the San Jacinto. These three ranges are located as follows:—

The Sierra Madre Mountains stretch westward from Cajon Pass for a distance of 55 miles, with a breadth of from 8 to

24 miles, and the main axis has a general direction from west to east.

The San Bernardino Mountains occupy a position intermediate between the Sierra Madre and the San Jacinto Mountains. They connect with the Sierra Madre Mountains at Cajon Pass, and are separated from the San Jacinto Mountains by the San Gorgonio Pass. The San Bernardino range stretches in a general direction from north-west to south-east, with a length of 45 miles and a width which varies from 12 miles at its north-west termination to 40 miles along its southern boundary.

The third of these ranges begins northerly at San Gorgonio Pass, a gap four or five miles wide between the San Bernardino and San Jacinto ranges. Here in this gap a western extension of the Colorado Desert connects with an eastern extension of the San Bernardino plains. Here, also, are located the towns of Banning and Beaumont, which have an elevation of about 2,500 feet. The San Jacinto range extends southward from San Gorgonio Pass for a distance of 25 miles.

These three ranges together have the smallest ratio of level area on them of any mountains in America ; ridge closely crowds on ridge, with generally only narrow canons in between.

The altitudes of the main divide of the Sierra Madre Mountains range from 6,000 to 10,000 feet, or, possibly, somewhat above the latter figure in the peak known as "Old Baldy," which is 50 miles north-east of Los Angeles. One of the noted points is Mount Wilson, upon which a popular summer camp is located at an altitude of 6,000 feet above sea-level. Another noted place on this range is Mount Lowe and its railroad. At the terminus of this railroad, at an altitude of 5,000 feet, is Alpine Tavern, which is a delightful resort and much frequented by the people of Southern California as well as by eastern tourists.

The Sierra Madre Mountains differ from the San Bernardino and the San Jacinto with reference to the configuration of the canons at the heads of the streams. In the two latter ranges most of the larger canons terminate in flats of plateau-like

basins, but in the Sierra Madre Mountains the heads of the streams are mostly situated directly in the steep slopes of the mountain spurs; often in a towering, precipitous wall of rock.

As you can imagine, these three ranges are the water reservoirs for the valley west of them. The Sierra Madre range supplies the Los Angeles Valley and a part of the San Bernardino Valley, while the water of the San Bernardino range flows into the San Bernardino plains. Practically all the visible water which flows from these three ranges is appropriated. Much of it is used for irrigation purposes, some supply drinking water for the various towns located on the plains, and some furnish power for electric lighting.

The amount of precipitation in all of these mountains ranges between 25 inches per annum at 5,000 feet altitudes, and diminishes at elevations lower than 4,500 feet, and rises to 30 or 40 inches above 6,000 feet. The actual amount of rain and snow in the higher altitudes is not known. The meteorological data for these mountains is very incomplete.

The above data are estimates made in the United States Geological Survey, twentieth annual report, 1898-99. The only actual record I have been able to secure of any observations are those taken by the Voluntary Government Observer at the Idyllwild Sanatorium,* beginning January, 1901. These show a precipitation as follows:—

January	4·03 inches.	July	·34 inches.
February	5·8 „	August	2·94 „
March	1·05 „	September	·00 „
April	·37 „	October	1·03 „
May	1·22 „	November	·69 „
June	·00 „	December	·34 „

making a total of 17·81 inches. There was snow in four of these months; that is:—

* Located in the Strawberry Valley on the southern slope of the San Jacinto Mountains at an altitude of 5,250 feet.

February	58·1 inches.	April	1·6 inches.
March	6·5 „	May...	·1 „

making a total of 66·3 inches for the twelve months. For 1902 the record shows as follows:—

January	24·3 inches.	April	10 inches.
February	—	May	2 „
March	22·3 „		

In regard to the relative humidity of these mountains there have been absolutely no observations until May 15, when observations were begun. We have the report for the fifteen days from May 15 to May 30, the observations having been taken at 7 a.m., 12 noon, and 5 p.m. On adding these fifteen days together and taking the average, we find that at 7 a.m. the relative humidity was 38, at 12 noon 68, and at 5 p.m., 85, making the mean relative humidity from those three daily observations, 60. You notice the difference between early in the morning, when the humidity is the lowest, and the afternoon, when it is over twice as great. The reason of this, of course, is that the diurnal breeze from the ocean brings moisture even at that high altitude and 100 miles from the sea, while during the night the breeze is entirely from the desert, reducing the humidity over half. It is this marked dryness of the atmosphere at night which makes it perfectly safe, not only to have the doors and windows wide open, but to sleep entirely in the open. This great advantage has not been insisted on at Idyllwild as much as it should have been, but I am sure, through the impressive suggestions of Drs. Bowditch, Solly, and others, on their recent visit to Idyllwild, that hereafter there will be no remissness on the part of the medical management there in enforcing practically the open-air life.

As to the temperature in these mountains. I must again depend entirely on the observations taken at Idyllwild, and for which the record is not as complete even as it is for the precipitation. These observations began with April, 1901, and are as follows:—

	Temperature.
April, mean maximum ...	60·9
Mean minimum	31·2
Maximum, April 24 ...	73
Minimum, April 3	15
May, mean maximum ...	66
Mean minimum	38
Maximum, May 31... ...	79
Minimum, May 3	27
June, mean maximum ...	75
Mean minimum	47
Maximum, June 28... ...	91
Minimum, June 11	33
July, mean maximum... ...	86
Mean minimum	55
Maximum, July 6	92
Minimum, July 1	45
August, mean maximum ...	79
Mean minimum	54
Maximum, August 26 ...	88
Minimum, August 24 ...	44
September, mean maximum...	75
Mean minimum	46
Maximum, September 14 ...	84
Minimum, September 23 ...	29
October, mean maximum ...	70
Mean minimum	40
Maximum, October 15 ...	80
Minimum, October 29 ...	27

	Temperature.
November, mean maximum...	60
Mean minimum	30
Maximum, November 4 ...	71
Minimum, November 11...	27
December, mean maximum...	55
Mean minimum	29
Maximum, December 23...	72
Minimum, December 13...	8
January, 1902, mean maximum	50·3
Mean minimum	26·5
Maximum, January 4 ...	70
Minimum, January 26 ...	6·5
February, mean maximum ...	58·6
Mean minimum	34·6
Maximum, February 16 ...	69
Minimum, February 1 ...	16
March, mean maximum ...	48·5
Mean minimum	26·5
Maximum, March 31 ...	63
Minimum, March 25 ...	11
April, mean maximum ...	64·3
Mean minimum	38·15
Maximum, April 26 and 29	78
Minimum, April 23 ...	17
May, mean maximum ...	65·8
Mean minimum	37
Maximum, May 29 ...	76
Minimum, May 20 ...	23·5

Now as to the number of clear days: our data, of course, only covers the same period, beginning with March, 1901. During that month there were twenty-three clear days and eight partly cloudy days. In April, 1901, there were twenty-three clear days and seven partly cloudy days. In May there were twenty-six clear days, one cloudy day, and four partly cloudy days. In June there were twenty-seven clear days and three partly cloudy days. In July twenty-five clear days and six partly cloudy. In August twenty-one clear and ten partly cloudy days. In September twenty-eight clear days and two partly cloudy. In October twenty-four clear days, one cloudy day, and six partly cloudy days. In November twenty-seven

clear days, one cloudy day, and three partly cloudy days, and in December there were twenty-six clear days, and five partly cloudy days.

In January, 1902, there were fourteen clear days, twelve partly cloudy and five cloudy days. And February, 1902, had seventeen clear days, four cloudy and seven partly cloudy days.

Even this inadequate record gives a fair idea of the dryness of the atmosphere and of the great number of days of sunshine, for of the seventy-three partly cloudy days a large proportion had a considerable amount of sunshine. The 281 days during the twelve months that are noted as "clear" were totally free from fog or cloud.

All of these mountains for years, have been resorts for our own people in summer, but Idyllwild, or rather, Strawberry Valley, in which Idyllwild is located, has long had a reputation that has attracted, every year, quite a number of cases of tuberculosis, and some before any sanatorium was projected had spent not only the spring, summer, and autumn, but also the winter months there in a primitive way, and have claimed to have derived great benefit therefrom. I believe that the reason why Strawberry Valley in the San Jacinto Mountains has gained this reputation is because of its close proximity to the desert; this portion of the mountains really standing out and being right in the desert air. I shall be very glad, as time goes on, to collate, with the help of the Weather Bureau, more satisfactory statistics upon which to base an opinion. One advantage of this location in the San Jacinto Mountains, aside from the altitude, dryness and the sunshine, is the atmosphere of the pine forests. Over all of these three ranges of mountains are scattered the pine and cedar of various varieties, but, according to Hon. T. P. Lukens, of the U.S. Department of Agriculture, the mountains in the region of Strawberry Valley display the greatest variety of any section of Southern California. The balsamic emanations from the trees have a healthful and healing influence, the shade of the trees add much to

the pleasure of the location, and the delightful walks, the climbs, and the drives through these mountain forests, add much to the encouragement of the patient in healthful exercise.

While there are, surrounding Strawberry Valley, quite a number of peaks of moderate altitude, yet San Jacinto Peak, which is a few hours' climb from Idyllwild, has an elevation of 11,000 feet. This peak surmounts a majestic mountain whose base rests in the desert below.† "It is not often that you find mountains with their feet thrust into tropical sands and their heads thrust into clouds of snow." Twice have I stood on this mountain pinnacle with the blue sky above me, a glorious realisation of that colouring never experienced before, while to the westward, 100 miles away, was the Pacific ocean shimmering in the afternoon sun; serried hosts of lesser peaks lay immediately below me, while between them and the ocean lay the rich, green squares of the far-famed orange orchards of Riverside. Turning about I faced the Colorado desert, stretching apparently interminably eastward. Here and there in that old sea-bed was the semblance of a struggling village, while fifty miles away were the glistening salt fields of what was formerly Salton Lake. Right at my feet was an abrupt vertical declivity, being the greatest of any mountain in the United States. And down this declivity a loosened rock would bound, never stopping for a distance of nearly two miles.

I have endeavoured to give you some idea of the natural conditions of this resort and of these mountains. As to the equipment and management of the Idyllwild Sanatorium, which is the only institution for the tuberculous in the mountains of California, I beg to refer you to a paper by Dr. Norman Bridge, that was written some time ago.

It is the intention of those who are interested in the Idyllwild Sanatorium to go on from month to month and year to year improving its equipment, and these improvements will be

† "The Desert," Jno. C. Van Dyke. Charles Scribner's Sons, 1901.

in a great degree due to the kind suggestions and friendly criticisms that have been made, and we trust will ever continue to be made by the members of the American Climatological Association.

The ninety physicians who have joined in purchasing the 4 284 acres of pine forest that include Strawberry Valley and the Idyllwild Sanatorium believe that, with the help of the Government in protecting intact the 734,000 acres of forest in the San Jacinto Mountains immediately surrounding Strawberry Valley, all of which belongs to the United States, that this will all become a haven for those with a tendency to pulmonary disease. Here for nine months in the year it is ideal camping. Spots can be selected isolated from the world, where the only noise is the music of the birds, the chatter of the squirrels, the babbling of the mountain streams, and the soughing of the pines. For him who can take an interest in flowers, trees, minerals, or the clear sky above him, apparently almost within reach, there is an unceasing source of pleasure and inspiration.

LITTORAL CALIFORNIA.

BY WILLIAM A. EDWARDS, M.D.
CORONADO, CALIFORNIA.

SOME confusion arises from the fact that strangers infer that the coast climate of Southern California is one common to the whole vast State line, with but little variation. This, however, is not the case; as a fact, there are three distinct climates on the coast and another, a fourth, on the great inland plain.

We shall barely mention the northern climatic belt, the centre of which is at the transverse junction of the mountain chain near the northern border of California and which embraces also the country known as Oregon, Washington, British Columbia, the coast of Alaska and its islands. The central

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NOTE.—The tables and statistics in this paper were prepared by Mr. Ford A. Carpenter, the very competent and courteous official in charge of the weather-bureau in San Diego. As he says, there are few places in the United States with a more complete climatic record than San Diego. This station was prominent among the selected few that telegraphed to Washington the first simultaneous observation, November 1, 1871. In addition to being among the favoured ones of the regular weather-service, San Diego has an uninterrupted temperature and rainfall record extending back for half a century. This station was also among the first to be completely equipped with self-recording apparatus. San Diego has had a continuous automatic record of temperature, rainfall, wind velocity, wind direction and sunshine for each moment of time, thus giving data that are absolutely reliable. It is on account of my familiarity with the excellent records of this station that San Diego and Coronado are selected as the type in this paper, but the statements and deductions apply almost equally to the coast of Southern California.

quite open to the sea, so that the Santa Clara Valley, the valley of the San Buenaventura River, the San Fernando Valley, the San Gabriel Valley, the valley of the Santa Ana River, the San Jacinto River, the Los Angeles River and plains and the San Diego country, become a great open coast land backed and protected by the high Sierras.

A new comer from the eastern country will be somewhat surprised at the designation of plains as applied to these valleys, and he will also be somewhat disappointed at their size; the first effect will probably be one of smallness and narrowness as compared with his homeland valleys, but their size is greatly increased by the hilly uplands into which they insensibly merge; this is most noticeable in the great upland plain of the San Jacinto, south towards San Diego.

As Lindley and Widney say, "The Sierra, which north of the Mojave Desert makes a great curve westward around the south end of the San Joaquin plain of the central belt, turns southward again opposite Santa Barbara and Ventura counties, and doubling back upon its course, walls in the west end of the desert, then turning directly eastward, separates the desert from the Los Angeles and San Bernardino plains. Turning southward again, it stands as a wall between the Colorado desert and that portion of Southern California lying west of its base." The range varies in height from five to seven thousand feet.

Unlike the northern and central portion of this chain it breaks down in the south, at several points, into low passes between the coast and the interior. "The pass by which the Central Pacific crosses the Sierra is 7,017 feet in elevation, yet the Soledad Pass, by which the Southern Pacific crosses the Sierra in Southern California, is only 2,822 feet; the Cajon Pass, by which the Santa Fé enters, is about the same height. There are numerous other comparatively low passes through the Sierras at the west end of the Mojave Desert, leading toward the sea in Ventura and Santa Barbara counties, and also through the range south of San Gorgonio. These passes through the

climatic subdivision extends from a point below the northward junction of the mountain just described to Point Conception on the coast. It is about here that the mountain chains transversely separate the State, and we are able to describe a northern and a southern California, each with its distinct topography and its very distinct climatic conditions.

Southern California, then, embraces as far as a study of its climate is concerned, all that part of the State below the transverse high mountains about Point Conception. It is with this strip of coast that the present communication is alone concerned; that is, from Point Conception to Coronado. At Point Conception the coast line changes its general direction and runs nearly east, the mountains also run eastward for sufficient distance to protect the country from the north, when they again turn south, offering another protection from the deserts which are east of them.

The trend of the coast and the arrangement of the mountains is the keynote of the charming climate offered by the coast of California of the South. The curve in the coast separates the Alaskan current from the land and the great Japan current, the Kurosiwo, leaves the land at Point Conception and never returns. The coast islands from San Miguel to Coronado Islands and further south off the coast of Baja California (Mexico) materially assist in this separation.

In order more fully to understand the factors that make the coast climate so delightful, we must for a moment consider the formation of the country contiguous to the coast of Southern California. The general topography of California, more marked in the north, is a double mountain range parallel with the long axis of the State, with large fertile plains and valleys included between them.

In the south this general plan is somewhat modified. While the eastern range, the Sierras, wall the country from the great arid desert plains, the coast range is much lower and no longer shuts out the sea, indeed at some points the whole interior is

southern Sierra have a marked influence not only upon the climate of the coast portion of Southern California but also upon that of the deserts lying at the base of the Sierra."

This, then, is the wide expanse of country that we must study when we are considering the climatic peculiarities of the coast of Southern California.

Rainfall.—The wet and the dry seasons are not hard-and-fast divisions of time. The first rain may occur in early October or middle November, or it may not come until December; it is usually over by April, so that December, January and February, have the heaviest fall.

The average coast rainfall for two of the coast cities, Santa Barbara and San Diego, is illustrated by the following table from the Government records, covering a period of twenty-four and forty-two years respectively. Each rainy season is a rule unto itself. It may be one of constantly recurring rains day after day until, as I have seen it, seven inches have fallen in a month, or the rains may be light, interspersed with a long period of almost constant sunshine. While, of course, the records shown are valuable, still they do not help us at all to predict for future rain probabilities. The last several years have been those of very deficient rainfall, indeed very far below the average determined by the Government records for many years preceding. This, however, is not altogether unusual, as San Diego, for example, with a normal rainfall of about ten inches (9·58) has had a minimum of 3·02 (1863) and a maximum of 27·59 (1884).

The coast fog, about which so much has been written, is most frequent during the months of April, May and June. The fog bank usually rolls in about nightfall and disappears a few hours after sunrise. About nine o'clock in the morning the coast is usually free from fog. During these months there are a few days, however, when the fog is more persistent and a fine mist lasts until half-past twelve or one o'clock; but this happens only perhaps on half a dozen days in the year.

Here again, in the matter of fogs, does Southern California

show its own peculiarities, for, as Solly says (page 308), owing undoubtedly to local conditions Los Angeles is more subject to fog than San Diego; he gives some statistics showing year by year a greater number of fogs at this inland station than on the coast. Last year Coronado and San Diego had two hundred and ninty-one clear days. Eastern maximum sunshine occurs in the summer, in Southern California in the winter; again the east has its cloudy weather in the winter, we have ours in the summer.

As will be seen by the accompanying table, the relative humidity at the coast is about 70 per cent. (72 per cent.); this is over four grains of vapour to each cubic foot of air.

Carpenter very aptly remarks that the oft repeated statement, "driest marine climate," as applied to San Diego, is not sufficiently explained. Why is our humidity so much less than that of Seattle or Santa Barbara, for example? We find the explanation in these two circumstances: distance from the average storm track and nearness to the desert. Our humidity is as constant as our temperature, and plays a very important part in the excellence of this climate. So long as the temperature is between 55 degrees and 65 degrees (and that is about half the time), the humidity is always 70 per cent. Whenever the temperature increases, the amount of moisture naturally decreases, for the capacity of the air for holding vapour is correspondingly increased. Strange as it may seem, this is also true of the other extreme in temperature in this desert-sea climate, so the winter cold is a dry cold as well as the summer heat is a dry heat. Solly concisely puts it when he says that, in order to have a general knowledge of the climate of Southern California, we must remember that the coast is cool and moist, and the interior hot and dry; "it should be thoroughly understood by the eastern visitor in search of health that if he seeks more days of sunshine and more opportunities for out-door life, with a more equable temperature and an average humidity a little greater than that of New York or

Total number of days on which precipitation has fallen since November 1, 1871.

	January	February	March	April	May	June	July	August	September	October	November	December
Less then 0.01	19	22	42	17	44	18	11	17	15	26	15	22
0.01 to 0.10	71	72	83	58	80	31	4	10	15	38	43	64
0.11 to 0.25	33	34	33	36	8	3	0	1	2	24	20	35
0.26 to 0.50	38	20	43	16	8	0	0	2	1	3	16	30
0.51 to 1.00	20	22	21	10	5	0	0	0	0	4	10	20
Over 1.00 inch	14	11	5	1	2	0	1	0	0	1	2	13

No snow is reported to have fallen in San Diego since the beginning of the record of observations in 1850.

Maximum rate of rainfall from recording rain-guage; record since 1893: December 28, 1896, in 1 minute, 0.19; in 5 minutes, 0.32; in 10 minutes, 0.47; in 1 hour, 0.79.

Dates when precipitation equalled or exceeded 2.50 inches in any consecutive 24 hours.—Local time.

December 4th, 1873, 10 P.M. 3d, during night 4th. . . . . 2.52 inches.
November 9th, 1879, during A. M. 9th to 8.10 P.M. 9th. . . . . 2.75 inches.
December 27th, 1879, 6 A.M. to 6 A. M. December 28th. . . . . 2.55 inches.
January 12th, 1882, 3.50 A.M. to 3 A.M. January 13th. . . . . 2.94 inches.

Rain	November	December	January	February	March	April	May to October	Length of record
Santa Barbara	1.6	3.9	3.7	3.8	2.1	1.4	1.3	Twenty-four years.
San Diego . .	1.0	2.1	1.6	2.1	1.0	1.0	1.0	Forty-two years.

In the table below will be found the following data: "A"—Greatest monthly precipitation and date: "B"—Least monthly precipitation and date. "C"—Number of times monthly precipitation has exceeded the normal for fifty-two years.

Table "A"	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Year . . .	1895	1884	1867	1878	1884	1850	1865	1873	1861	1889	1860	1889
Amount .	7.33	9.05	7.88	2.91	2.17	0.68	1.29	1.95	1.59	2.12	2.88	7.71
Table "B"												
Year . . .	†1850	†1885	†1857	†1864	†1850	†1852	†1850	†1850	†1850	†1853	†1872	1900
Amount .	0	0.02	0	0.01	0	0	0	0	0	0	0	0
Table "C"												
Total . .	17	18	21	18	16	11	8	10	7	15	21	16

† Also in other years.

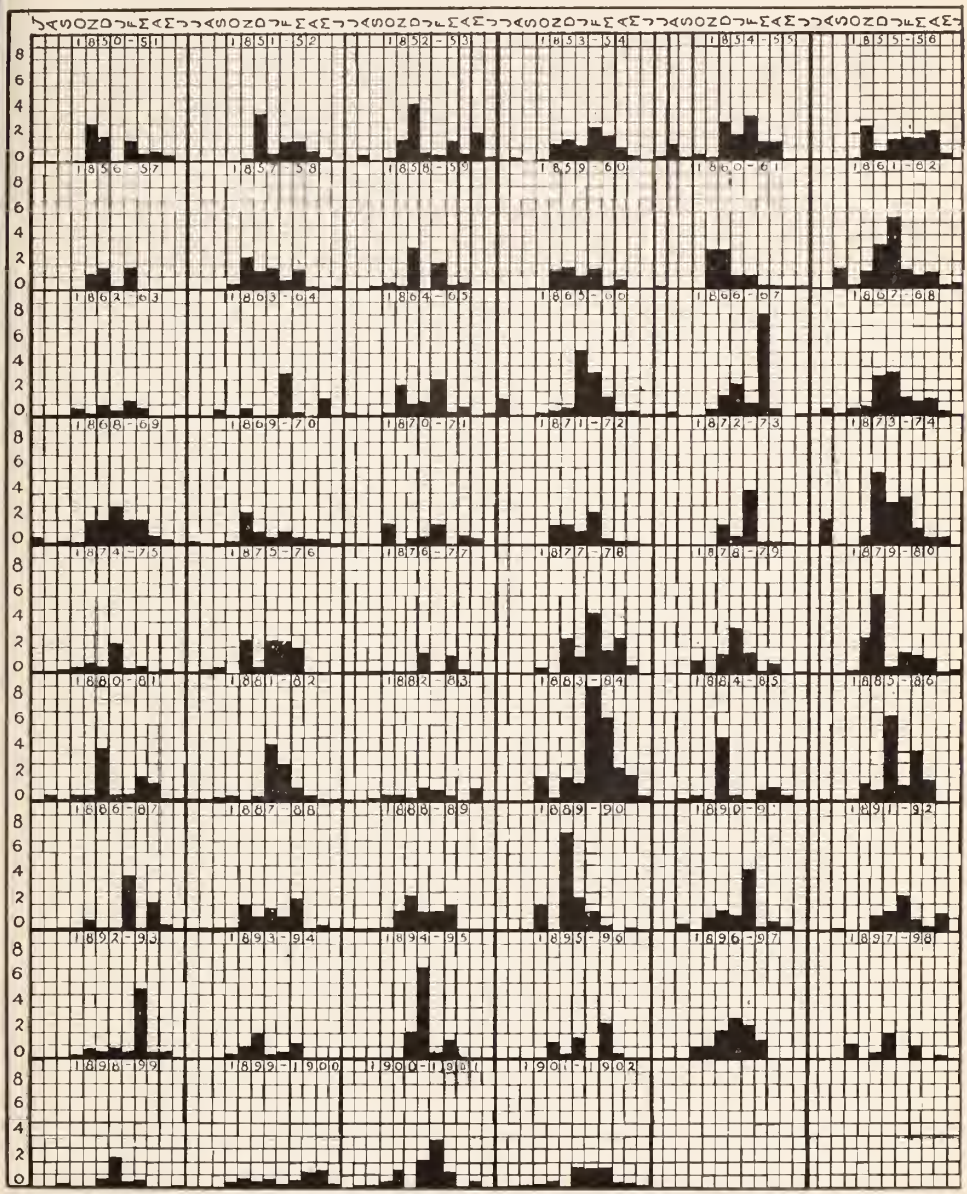


Chart of Seasonal Rainfall of San Diego, California.

Number of days with one hour or more of fog, and number of thunder-storms in 10 years. Record began January 1, 1890.

	January	February	March	April	May	June	July	August	September	October	November	December	Sum
Total number of foggy days . . .	17	13	9	15	2	6	4	3	18	22	15	10	116
Average . . .	2	1	1	2	0	1	0	0	2	3	2	1	14
Total number of thunderstorms .	0	2	1	1	1	0	2	3	0	6	0	1	17
Average . . .	0	0	0	0	0	0	0	0	0	1	0	0	8

Monthly relative humidity (per cent.) for a period of 31 years. Record began January 1, 1871.

	January	February	March	April	May	June	July	August	September	October	November	December
A. M.	72.9	77.6	81.2	82.2	82.5	84.3	85.9	85.4	84.7	81.3	72.4	75.0
P. M.	73.0	73.5	73.9	73.4	74.8	75.9	76.4	76.4	78.0	76.2	72.8	72.9
Average . .	73.4	75.6	77.6	77.8	78.6	80.5	81.2	80.9	81.4	78.8	72.6	72.9

Greatest precipitation in 24 hours for each month.

Year	January	February	March	April	May	June	July	August	September	October	November	December	Greatest Annual
1872 . . .	0.53	1.12	0.29	0.15	0.10	0.00	0.00	0.09	0.00	0.00	0.00	0.53	1.12
1873 . . .	0.20	1.25	0.05	0.10	0.02	0.00	0.00	1.80	0.00	0.00	0.34	2.52	1.80
1874 . . .	1.35	1.21	0.28	0.33	0.21	0.00	0.09	0.00	0.10	0.18	0.31	0.55	1.35
1875 . . .	0.95	0.35	0.30	0.11	0.08	0.02	0.00	0.21	0.29	0.00	0.52	0.32	0.95
1876 . . .	0.35	1.53	0.80	0.05	0.05	0.05	0.03	0.06	0.03	0.06	0.03	0.10	1.53
1877 . . .	0.11	0.18	0.52	0.16	0.20	0.00	0.00	0.00	0.00	0.78	0.06	1.09	1.09
1878 . . .	0.55	1.11	0.36	0.82	0.28	0.07	0.00	0.00	0.00	0.96	0.00	0.58	0.96
1879 . .	1.53	0.80	0.05	0.17	0.00	0.07	0.00	0.00	0.00	0.16	2.75	2.55	2.75
1880 . .	0.31	0.82	0.44	0.38	0.06	0.06	0.07	0.28	0.00	0.18	0.17	1.29	1.29
1881 . . .	0.29	0.18	0.83	0.70	0.02	0.05	0.00	0.01	0.01	0.21	0.07	0.19	0.83
1882 . . .	2.94	0.99	0.55	0.13	0.17	0.05	0.00	0.00	0.01	0.21	0.31	0.11	2.94
1883 . . .	0.98	0.43	0.19	0.18	0.69	0.08	0.00	0.00	0.00	1.82	0.20	0.63	1.82
1884 . . .	0.92	1.89	1.71	1.01	1.15	0.24	0.00	T	0.07	0.23	0.10	1.66	1.89
1885 . . .	0.20	0.01	0.56	0.80	0.54	0.01	T	0.13	0.00	0.21	0.59	0.48	0.80
1886 . . .	1.76	0.60	1.38	1.20	0.02	0.04	T	T	0.00	0.05	0.74	0.06	1.76
1887 . . .	0.04	1.95	0.02	0.94	0.44	0.01	0.01	T	T	T	1.80	0.74	1.96
1888 . . .	0.75	0.60	1.25	0.08	0.15	0.01	0.01	T	0.04	0.20	0.60	1.04	1.25
1889 . . .	0.67	0.95	1.16	0.14	0.02	0.10	T	0.04	T	1.54	0.08	2.31	2.31
1890 . . .	1.32	1.01	0.35	0.03	0.04	0.00	0.00	T	0.37	0.01	0.72	1.23	1.32
1891 . . .	1.08	1.35	0.17	0.55	0.34	0.05	T	0.00	0.08	0.02	0.09	0.69	1.35
1892 . . .	1.25	1.25	0.34	0.41	0.95	0.13	0.00	0.04	T	0.10	0.82	0.43	1.25
1893 . . .	0.15	0.43	2.00	0.22	0.22	T	T	0.00	0.00	0.11	0.81	0.74	2.00
1894 . . .	0.20	0.15	0.65	0.06	0.08	0.01	0.00	0.04	0.01	T	0.00	0.59	0.65
1895 . . .	2.15	0.29	0.70	0.08	0.15	0.00	0.00	0.00	0.01	0.22	0.16	0.15	2.15
1896 . . .	0.57	0.02	1.32	0.12	0.03	0.01	T	0.09	T	0.64	0.88	1.10	1.32
1897 . . .	1.62	1.04	0.55	0.02	0.04	T	0.01	T	T	0.67	0.02	0.17	1.62
1898 . . .	0.55	0.06	0.47	0.09	0.26	0.02	0.00	0.00	0.06	0.00	0.11	0.71	0.71
1899 . . .	1.33	0.21	0.52	0.28	0.07	0.25	0.00	0.07	0.00	0.20	0.42	0.54	1.33
1900 . . .	0.66	0.03	0.48	0.79	1.35	0.05	0.00	T	T	0.20	0.52	0.00	1.35
1901 . . .	0.74	2.39	0.53	0.01	0.52	0.02	T	T	0.06	0.22	0.41	0.01	2.39
1902 . . .	0.54	1.16	0.40	0.20	0.05	T							

Average hourly wind velocity. Record began January 1, 1873.

	January	February	March	April	May	June	July	August	September	October	November	December
A. M., 1 . . .	3.8	4.0	3.7	3.6	3.5	3.1	2.7	2.5	2.6	2.7	3.1	3.6
2 . . .	3.8	4.1	3.8	3.6	3.4	3.1	2.5	2.3	2.6	2.7	3.2	3.8
3 . . .	3.8	3.9	3.8	3.6	3.4	3.0	2.4	2.2	2.6	2.9	3.3	3.9
4 . . .	3.9	4.0	3.8	3.5	3.4	3.1	2.4	2.3	2.7	2.8	3.2	3.9
5 . . .	4.0	4.1	4.0	3.6	3.4	3.2	2.5	2.3	2.7	2.9	3.4	3.9
6 . .	4.1	4.1	4.0	3.6	3.5	3.2	2.6	2.4	2.7	2.9	3.5	3.9
7 . . .	3.9	3.9	4.0	3.7	3.6	3.2	2.6	2.3	2.8	2.9	3.4	3.9
8 . . .	3.9	4.1	4.0	3.7	3.4	3.2	2.7	2.4	2.7	3.2	3.5	3.8
9 . . .	3.9	4.1	4.0	3.7	3.3	3.2	2.8	2.5	2.8	3.1	3.6	3.9
10 . . .	4.0	4.2	3.8	3.5	3.6	3.4	3.1	2.6	2.8	3.0	3.5	4.0
11 . .	3.7	4.0	3.7	3.9	4.3	4.1	4.0	3.4	3.2	3.0	3.1	3.9
Noon, 12 . . .	3.3	3.8	4.3	4.8	5.6	5.6	5.7	5.0	4.6	3.8	3.1	3.4
P. M. 1 . . .	3.5	4.7	5.6	7.0	7.8	7.7	7.7	7.1	6.7	5.5	4.4	3.9
2 . . .	4.5	5.9	7.0	8.7	9.0	9.2	9.1	8.9	8.7	7.4	5.8	4.9
3 . . .	5.9	7.5	8.5	9.9	10.0	10.0	10.1	9.9	10.0	9.0	7.4	6.4
4 . .	7.3	8.8	9.5	10.5	10.5	10.5	10.3	10.2	10.5	9.6	8.7	7.6
5 . . .	8.0	9.6	10.0	10.6	10.5	10.5	10.3	10.2	10.4	9.8	9.1	8.3
6 . . .	8.3	9.7	9.9	10.3	10.3	10.1	10.0	9.8	9.9	9.4	8.7	8.0
7 . .	8.1	9.2	9.4	9.6	9.6	9.4	9.3	9.2	9.0	8.4	7.6	7.0
8 . . .	6.7	8.0	8.5	8.7	8.8	8.6	8.4	8.3	8.0	6.8	5.7	5.5
9 . . .	4.9	6.1	6.9	7.4	7.5	7.4	7.5	8.3	6.3	4.8	3.9	4.3
10 . . .	4.0	4.6	5.1	5.7	6.1	6.0	6.1	7.1	4.8	3.5	3.2	3.8
11 . . .	3.8	4.0	4.1	4.5	4.9	4.9	4.7	5.4	3.6	3.0	3.1	3.8
Midnight, 12.	3.8	4.0	3.8	3.8	4.0	3.8	3.6	4.1	3.0	2.6	3.1	3.8
Average . .	4.8	5.4	5.5	5.9	6.0	5.8	5.5	5.4	5.2	4.8	4.6	4.7

Total number of high winds in 31 years. Record began January 1, 1873.

	January	February	March	April	May	June	July	August	September	October	November	December	Annual Average
Velocity 25 to 30 miles	8	8	11	8	3	0	3	1	1	4	5	11	2
Velocity 21 to 40 miles	11	8	6	3	0	0	0	0	0	1	2	4	1

Highest Wind Velocity, direction and date for each month, during the past 29 years. Record began January 1, 1873.

Months	Velocity	Direction	Day and Year	
January	37	*	*	1873
February	40	nw.	*	1878
March	37	*	*	1876
April	39	*	*	1877
May	28	*	*	1877
June	24	sw.	11,	1886
July	30	nw.	2,	1881
August	25	sw.	3,	1900
September	28	nw.	7	1881
October	32	nw.	29,	1877
November	32	nw.	‡12,	1877
December	36	nw.	§ 2,	1887

* Direction and date missing. ‡ Also on November 21, 1886. § Also west, on December 23, 1888.

CLIMATOLOGY OF SAN DIEGO, CALIFORNIA.

By FORD A. CARPENTER, Observer, Weather Bureau.

Monthly mean temperatures for a period of fifty-two years.

Year.	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual
1852	53.1	55.9	55.0	57.6	61.2	67.1	73.2	72.5	73.6	65.0	57.3	51.9	62.0
1853	53.8	53.0	57.7	62.6	63.3	68.4	72.8	72.9	70.7	68.8	60.4	56.2	63.4
1854	54.2	55.0	56.4	63.3	60.7	64.1	73.1	72.1	66.7	64.0	58.7	55.5	62.0
1855	52.6	56.2	58.4	62.3	64.0	68.8	70.9	72.0	68.3	66.6	56.4	52.4	62.4
1856	51.0	53.5	56.2	60.0	61.0	68.6	72.3	72.5	68.8	61.6	56.2	50.0	61.0
1857	52.4	53.6	58.8	62.6	64.4	69.1	67.3	72.8	68.4	63.9	57.2	51.8	61.9
1858	51.2	56.0	55.1	57.8	62.8	66.5	69.2	69.8	69.6	63.5	58.6	53.1	61.1
1859	54.5	54.8	55.3	56.2	60.1	67.0	69.7	68.4	66.6	65.1	60.1	55.3	61.1
1860	51.4	53.9	59.0	60.4	61.9	64.5	68.8	70.8	69.1	63.6	56.9	55.2	61.3
1861	51.4	56.5	57.7	63.8	65.7	67.6	73.1	72.3	69.3	64.6	59.8	58.1	63.3
1862	55.6	51.8	56.8	59.4	62.7	68.2	71.2	72.9	69.4	65.8	60.4	55.4	62.5
1863	52.8	52.8	59.9	61.0	62.6	64.6	68.0	68.1	68.9	6[illegible].7	59.0	55.8	61.6
1864	56.0	56.2	58.5	61.8	65.2	69.0	69.7	75.1	69.2	64.6	59.1	56.5	63.4
1865	55.6	54.7	57.8	59.8	64.3	65.7	67.7	71.8	68.2	65.2	62.1	52.2	62.1
1866	54.5	57.0	57.9	62.7	60.5	66.6	69.7	73.1	69.6	65.0	60.4	58.6	63.0
1867	55.2	53.2	55.4	61.7	63.6	69.1	70.5	74.5	71.7	64.0	63.2	63.3	63.8
1868	54.5	56.5	57.4	61.3	62.3	65.7	69.4	74.1	72.2	66.1	62.1	55.4	63.1
1869	56.6	55.6	59.8	62.1	62.2	64.4	68.8	70.3	68.3	66.3	61.1	50.6	62.2
1870	55.6	57.5	56.3	58.8	61.4	64.6	68.3	70.5	66.9	63.6	59.4	51.4	61.2
1871	53.5	52.2	56.7	57.7	63.6	65.1	71.4	72.1	68.3	65.6	58.3	56.8	61.8
1872	52.7	55.2	56.4	56.0	60.4	64.9	66.6	68.9	66.0	62.5	59.4	55.4	60.4
1873	56.7	53.3	56.7	58.0	60.0	62.7	67.0	69.0	67.7	62.0	60.3	51.3	60.0
1874	54.7	52.6	52.6	56.2	60.5	63.2	68.3	68.1	65.7	63.2	56.7	53.3	59.6
1875	53.4	54.6	55.0	57.8	62.6	64.6	68.3	71.2	67.7	67.2	60.3	56.9	61.6
1876	51.9	55.9	54.9	59.0	60.9	65.2	68.3	68.8	66.3	64.6	59.4	56.8	61.0
1877	57.4	57.9	58.9	58.3	60.3	66.3	68.4	68.4	68.0	63.9	60.6	56.8	62.1
1878	55.6	56.0	56.7	58.1	61.5	64.1	66.8	68.3	67.3	62.0	57.5	53.5	60.6
1879	52.3	54.8	57.9	53.1	60.1	64.1	65.7	68.6	66.6	62.6	56.2	53.9	60.1
1880	52.5	50.8	52.1	56.5	60.6	63.0	63.4	65.8	63.1	61.2	56.2	56.9	58.5
1881	52.8	55.7	54.3	60.8	62.3	64.1	67.2	68.2	66.7	61.5	56.8	55.0	60.4
1882	50.4	51.2	55.1	56.6	61.9	64.3	66.7	70.2	66.8	62.0	57.0	55.7	59.8
1883	53.4	53.9	57.4	57.4	60.6	66.6	68.7	68.9	69.7	61.7	58.7	57.5	61.2
1884	55.0	55.9	56.5	57.6	61.4	64.4	68.4	69.5	65.1	61.3	58.6	54.4	60.7
1885	54.0	55.4	59.6	62.0	63.3	64.3	67.6	71.8	68.0	63.9	59.6	57.1	62.2
1886	55.9	58.5	55.0	57.2	60.4	63.1	67.1	70.5	66.6	59.7	56.0	56.0	60.5
1887	51.3	52.9	57.2	59.0	62.1	64.6	66.5	66.2	65.7	64.5	59.2	54.6	60.6
1888	51.6	54.9	55.8	60.8	61.2	66.0	68.4	69.2	69.7	65.0	59.9	58.2	61.7
1889	54.8	58.0	59.2	60.4	60.8	64.0	67.6	70.8	70.2	65.4	62.0	57.4	62.6
1890	51.0	54.3	56.4	58.6	60.4	64.1	68.5	69.8	69.1	64.6	63.8	60.8	61.8
1891	54.6	53.3	56.9	58.2	60.8	65.6	69.9	72.4	70.2	63.8	59.2	61.5	62.0
1892	55.1	55.0	56.0	57.8	61.0	62.0	64.9	67.8	65.4	62.7	60.9	54.2	60.2
1893	57.4	54.4	54.2	57.5	61.0	63.4	67.4	70.0	64.6	62.7	57.6	57.4	60.6
1894	49.5	50.5	52.6	56.4	58.6	61.4	64.8	67.0	65.9	62.8	57.1	54.8	58.4
1895	53.2	55.8	55.4	57.8	61.9	65.0	65.6	61.7	67.4	64.4	59.4	55.0	60.5
1896	55.5	57.7	58.2	56.5	62.0	64.8	68.6	69.4	66.7	64.2	59.7	59.0	61.9
1897	55.8	54.7	54.2	59.8	60.9	63.4	67.0	69.9	68.1	62.4	60.2	55.0	61.0
1898	50.8	55.2	54.5	59.1	58.8	63.8	66.7	70.6	68.5	62.3	59.4	56.6	60.5
1899	55.5	53.4	56.4	58.2	57.7	61.4	65.6	65.8	65.5	62.7	60.8	58.7	60.1
1900	57.8	57.6	59.2	56.8	60.9	64.4	67.6	66.2	65.6	63.1	64.6	60.4	62.0
1901	56.2	57.5	60.0	57.4	60.0	62.5	65.6	68.2	64.8	62.8	60.8	57.8	61.2
1902	56.4	54.8	54.8	57.2	60.2	62.2							
Mean	53.9	54.8	56.5	59.1	61.5	65.1	68.4	70.0	67.9	63.9	59.2	55.7	61.3

Monthly, seasonal and annual precipitation at San Diego, California.

YEAR.	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Annual	Season of	Seasonal
1850	0.00	1.13	1.00	0.09	0.00	0.68	0.00	0.00	0.00	0.19	2.82	1.93	7.84	1849-50	. . .
1851	0.03	1.51	0.34	0.87	0.71	0.01	0.00	0.00	0.02	0.01	0.25	3.74	7.49	1850-51	8.41
1852	0.58	1.84	1.87	0.85	0.32	0.00	0.00	0.40	0.00	0.06	1.45	4.50	11.87	1851-52	9.88
1853	0.50	0.20	1.52	0.25	2.10	0.05	0.00	0.21	0.00	0.00	1.28	1.77	7.88	1852-53	10.85
1854	0.99	2.56	1.88	0.89	0.18	0.01	0.07	1.36	0.09	0.27	0.04	3.29	11.63	1853-54	10.99
1855	1.97	3.59	1.30	1.52	0.06	0.00	0.00	0.04	0.00	0.11	2.15	0.41	11.15	1854-55	12.17
1856	1.27	1.86	1.59	2.17	0.29	0.00	0.00	0.00	0.07	0.00	1.22	1.30	9.77	1855-56	9.85
1857	0.26	1.76	0.00	0.04	0.09	0.03	0.00	0.02	0.01	0.49	2.16	1.30	6.15	1856-57	4.78
1858	1.52	0.44	1.24	0.17	0.00	0.19	0.00	0.04	0.10	0.47	0.28	3.10	7.55	1857-58	7.56
1859	0.00	1.89	0.20	0.36	0.17	0.00	0.02	0.00	0.00	0.18	1.49	1.79	6.10	1858-59	6.59
1860	0.72	1.49	0.15	0.65	0.04	0.05	0.14	0.00	0.00	0.00	2.88	2.99	9.11	1859-60	6.70
1861	0.82	0.79	0.05	0.04	0.00	0.19	0.00	0.00	1.59	0.05	1.19	3.20	7.92	1860-61	7.76
1862	5.56	1.39	0.97	1.05	0.16	0.48	0.11	0.00	0.00	0.89	0.05	0.93	11.59	1861-62	15.75
1863	0.32	1.09	0.32	0.13	0.02	0.00	0.00	0.00	0.36	0.00	0.73	0.04	3.02	1862-63	3.76
1864	0.04	2.50	0.20	0.01	1.25	0.01	0.11	0.00	0.00	0.04	2.41	1.04	7.61	1863-64	5.25
1865	1.28	3.00	0.00	0.56	0.00	0.07	1.29	0.00	0.00	0.02	0.52	0.84	7.52	1864-65	9.63
1866	5.05	3.43	1.47	0.11	0.09	0.00	0.00	0.10	0.00	0.00	0.24	1.82	12.31	1865-66	11.63
1867	2.32	0.85	7.88	0.48	0.04	0.00	0.00	0.30	0.00	0.34	0.45	3.06	15.72	1866-67	13.93
1868	3.37	1.63	0.73	1.20	0.15	0.00	0.51	0.00	0.05	0.00	2.00	1.52	11.16	1867-68	11.44
1869	2.88	1.88	1.98	0.53	0.33	0.00	0.05	0.00	0.00	0.05	2.32	0.94	10.96	1868-69	11.22
1870	0.54	0.77	0.33	0.20	0.28	0.00	0.04	0.07	0.00	1.54	0.18	0.42	4.37	1869-70	5.54
1871	0.52	1.35	0.01	0.70	0.34	0.00	0.00	0.00	0.00	0.00	1.33	1.39	5.64	1870-71	5.06
1872	0.99	2.63	0.46	0.26	0.12	0.00	0.00	0.18	0.00	0.00	0.00	1.40	6.04	1871-72	7.36
1873	0.44	4.15	0.11	0.10	0.03	0.00	0.00	1.95	0.00	0.00	0.77	5.46	13.01	1872-73	8.18
1874	3.11	3.73	1.20	0.34	0.34	0.00	0.12	0.00	0.11	0.53	0.88	0.55	10.91	1873-74	15.07
1875	2.38	0.37	0.45	0.12	0.20	0.02	0.00	0.21	0.39	0.00	2.25	0.41	6.80	1874-75	5.82
1876	2.47	2.44	1.78	0.06	0.05	0.05	0.03	0.06	0.03	0.08	0.04	0.15	7.24	1875-76	9.99
1877	1.05	0.18	1.44	0.26	0.43	0.00	0.00	0.00	0.00	0.81	0.06	3.89	8.12	1876-77	3.66
1878	1.45	4.83	1.41	2.91	0.58	0.16	0.00	0.00	0.00	0.96	0.00	1.57	13.87	1877-78	16.10
1879	3.51	1.04	0.10	0.60	T	0.07	0.00	0.00	0.00	0.29	2.77	6.30	14.71	1878-79	7.88
1880	0.61	1.50	1.43	1.34	0.06	0.06	0.09	0.32	0.00	0.53	0.28	4.15	10.37	1879-80	14.77
1881	0.52	0.55	1.88	1.35	0.04	0.05	0.00	0.01	0.04	0.24	0.12	0.30	5.00	1880-81	9.26
1882	4.53	2.55	1.02	0.45	0.18	0.07	0.00	T	0.01	0.41	0.39	0.13	9.74	1881-82	9.50
1883	1.09	0.95	0.41	0.31	1.14	0.08	0.00	0.00	0.00	2.01	0.20	1.82	8.01	1882-83	4.92
1884	1.34	9.05	6.23	2.84	2.17	0.31	0.00	T	0.07	0.35	0.11	5.12	27.59	1883-84	25.97
1885	0.35	0.02	0.78	1.20	0.61	0.06	T	0.13	T	0.31	1.56	0.71	5.73	1884-85	8.80
1886	6.95	1.51	3.73	1.95	0.04	0.07	T	T	0.00	0.05	0.95	0.10	15.35	1885-86	16.83
1887	0.04	4.51	0.02	2.14	0.47	0.04	0.01	T	T	T	2.08	1.14	10.45	1886-87	8.33
1888	1.96	1.48	2.79	0.10	0.22	0.04	0.01	T	0.04	0.26	1.83	2.84	11.57	1887-88	9.82
1889	1.72	1.80	2.20	0.19	0.03	0.10	T	0.04	T	2.12	0.12	7.71	16.03	1888-89	11.05
1890	2.79	1.70	0.41	0.05	0.08	0.00	0.00	T	0.65	0.01	0.72	1.61	8.02	1889-90	14.98
1891	1.21	4.84	0.27	0.76	0.35	0.05	T	0.00	0.08	0.04	T	1.29	8.99	1890-91	10.47
1892	1.58	2.96	0.96	0.41	1.15	0.13	0.00	0.05	T	0.22	0.94	0.69	9.09	1891-92	8.65
1893	0.78	0.47	5.50	0.22	0.39	T	T	0.00	0.00	0.11	0.91	1.91	10.29	1892-93	9.21
1894	0.29	0.49	1.05	0.11	0.09	0.01	0.00	0.04	0.01	T	0.00	2.26	4.35	1893-94	5.01
1895	7.33	0.53	1.43	0.11	0.19	0.00	0.00	0.00	0.01	0.27	1.19	0.27	11.33	1894-95	11.86
1896	1.27	0.02	2.89	0.25	0.03	0.01	T	0.13	T	0.97	0.98	2.18	8.73	1895-96	6.34
1897	3.13	2.72	1.53	0.02	0.12	T	0.01	T	T	1.06	0.02	0.32	8.93	1896-97	11.66
1898	1.71	0.06	0.91	0.22	0.66	0.02	0.00	0.00	0.07	0.00	0.15	0.87	4.67	1897-98	4.98
1899	2.34	0.30	0.85	0.29	0.10	0.27	0.00	0.07	0.00	0.35	0.86	0.65	6.08	1898-99	5.31
1900	0.69	0.03	0.53	1.26	1.45	0.08	0.00	T	T	0.30	1.43	0.00	5.77	1899-00	5.90
1901	2.08	4.77	1.07	0.01	0.77	0.02	T	T	0.06	0.28	0.41	0.02	9.49	1900-01	10.45
1902	1.70	1.57	1.86	0.21	0.06	T								1901-02	6.22
General Average	1.75	1.88	1.37	0.64	0.34	0.07	0.05	0.10	0.07	0.33	0.95	1.96	9.54		9.55

Maximum and minimum temperatures for a period of 31 years.

Year.	January		February		March		April		May		June		July		August		Sept.		October		Nov.		Dec.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1872	73	37	68	44	71	44	74	43	83	52	80	55	75	58	86	60	80	54	87	45	81	42	72	40
1873	75	41	77	37	72	40	82	42	78	52	75	58	77	60	78	63	82	55	76	49	85	49	68	41
1874	71	42	64	41	63	41	71	43	74	50	76	52	79	59	83	56	78	51	90	46	75	45	82	39
1875	68	42	70	44	71	39	77	39	82	50	77	53	79	61	83	63	88	57	88	53	78	50	75	38
1876	65	39	77	39	75	43	87	43	76	50	88	51	78	60	81	60	82	54	80	48	79	43	77	43
1877	78	42	75	45	70	48	67	44	68	51	94	55	86	59	82	58	91	58	73	47	78	46	78	40
1878	68	38	69	44	68	42	77	44	73	48	76	51	77	56	80	55	100	53	87	44	77	40	79	35
1879	76	35	74	38	99	44	82	45	94	47	93	52	75	58	81	54	92	51	92	46	79	43	71	32
1880	73	32	63	35	69	38	80	42	81	46	73	52	73	54	84	56	82	50	81	48	78	40	77	40
1881	70	36	82	39	72	40	82	51	72	51	76	53	80	57	82	56	86	52	72	46	76	38	77	39
1882	64	34	70	37	79	39	70	43	73	48	75	55	78	57	83	62	80	50	81	49	80	42	78	41
1883	76	32	83	36	71	48	85	42	89	45	84	56	80	59	84	60	101	59	80	48	82	43	78	42
1884	78	39	79	38	68	43	69	45	72	47	81	50	84	54	92	54	78	51	87	47	74	42	68	36
1885	68	38	76	40	81	42	83	47	73	52	74	52	82	58	89	62	90	56	88	47	76	42	79	40
1886	74	35	80	44	68	41	71	45	72	50	75	54	81	57	82	61	78	60	75	47	77	40	76	40
1887	74	38	76	38	82	41	80	44	79	48	78	54	79	60	77	54	79	58	85	50	82	41	74	36
1888	64	33	67	42	72	41	93	47	70	52	76	54	77	55	82	57	82	58	80	53	75	46	73	44
1889	78	36	85	37	80	45	83	47	80	50	72	56	84	59	89	62	91	54	80	52	83	46	69	40
1890	66	35	77	38	74	41	85	45	75	46	93	51	80	56	89	58	83	60	90	49	91	46	79	47
1891	76	35	70	34	76	41	77	44	67	53	78	53	88	58	85	60	89	55	81	50	82	41	72	32
1892	75	38	68	42	73	44	80	41	87	47	75	51	75	57	80	57	80	54	83	46	84	40	71	36
1893	80	38	75	40	75	40	78	43	88	49	75	53	79	57	81	59	77	53	88	50	83	40	82	38
1894	69	32	69	34	72	36	83	43	72	45	73	50	77	57	90	55	90	52	87	45	78	45	70	41
1895	77	36	82	39	74	38	81	44	80	51	77	51	74	57	78	54	90	54	81	54	85	38	79	34
1896	77	39	83	39	85	41	74	42	98	48	89	54	80	56	88	59	80	54	79	52	76	43	76	46
1897	73	40	76	38	70	40	88	46	67	50	70	54	79	59	89	60	83	58	76	51	83	45	80	36
1898	78	36	75	42	77	38	86	45	69	51	88	54	77	60	83	63	91	56	81	51	76	43	79	43
1899	74	43	76	34	86	41	93	46	66	48	70	55	78	57	76	58	92	55	93	48	81	50	80	46
1900	79	46	76	45	80	46	67	45	75	49	87	56	84	60	80	59	87	53	72	50	89	51	79	44
1901	75	40	83	44	82	47	66	46	67	51	86	53	74	57	79	58	72	56	96	51	80	49	76	35
1902	81	36	71	39	76	43	69	47	78	50	76	52												

Temperature and weather summaries for a period of fifty-two years.

Temperature.	Jan.	Feb.	Mar.	April	May	June	July	August	Sept.	Oct	Nov.	Dec.	Annual.
Highest monthly mean and year	57.8 1900	58.5 1886	60.0 1901	63.8 1861	65.7 1861	69.4 1857-67	73.2 1852	75.1 1864	73.6 1852	68.8 1853	64.6 1900	63.3 1867	63.8 1867
Lowest monthly mean and year	49.5 1895	50.5 1894	52.1 1880	56.0 1872	57.7 2899	61.4 1894-99	63.4 1880	65.8 1880-99	63.1 1880	59.7 1886	56.0 1886	50.0 1856	58.4 1894
Absolute maximum and date	81 4, 1902	85 12, 1889	99 27, 1879	93 12, 1888	98 25, 1896	94 10, 1877	88 25, 1894	92 15, 1884	101 22, 1883	96 21, 1901	91 4, 1890	82 6, 1874	101 Sept. 22, 1883
Absolute minimum and date	32 *31, 1880	34 10-11 '94	38 6, 1880 14, 1898	39 7, 1875	39 7, 1875	50 14, 1884 13, 1894	54 16, 1894	54 29, 1879	50 18, 1882	44 30, 1878	38 8, 1881 24, 1895	32 25, 1879	32 Jan. 31, 1880 Dec. 25, 1879
Greatest daily range	35	37	43	40	36	35	22	28	35	37	34	40	43
Mean daily range	16.9	13.7	14.2	14.2	12.2	12.1	11.6	11.4	13.0	14.1	17.7	16.2	13.9
Mean variability	2.4	2.1	2.3	2.2	1.6	1.6	1.7	1.7	2.0	1.8	2.3	1.9	2.0
Mean of three consecutive warmest days	65.7	69.2	71.3	74.3	72.1	75.8	78.0	81.1	82.9	79.0	75.6	75.6	82.9
Mean of three consecutive coldest days	40.2	41.9	44.3	50.5	52.6	55.4	59.5	60.8	57.0	49.8	41.9	42.8	40.2
WEATHER													
Average number of clear days	17	14	11	13	9	8	14	12	16	18	19	17	178
Average number of partly cloudy days	7	9	10	10	11	13	11	15	11	10	9	10	116
Average number of cloudy days	7	5	10	7	11	9	6	4	3	3	2	4	71
Average number of rainy days	6	8	7	4	3	1	0	0	0	2	3	5	39

*Also 21st, 1883; 7th, 1894.

Boston, he can find what he wants at Santa Barbara or San Diego," or Coronado.

The wind movement is moderate, the yearly average is about 5·6 miles per hour. During the day the wind blows from nearly every point of the compass. The coast clearly shows the phenomenon of land and sea breezes as the air, warmed by the earth, rises and creates a draft from the cooler sea, so that by about 9 a.m., the breeze commences and increases until about 2 p.m., when it is blowing at about the average rate of 12 miles an hour. At or about sunset this westerly wind dies down, the land cools and the current of air starts toward the warmer sea.

As I have said elsewhere,* a great deal that is misleading has been written about the climate of Southern California. Its charms have been exaggerated and its drawbacks either passed over in silence or painted in glowing and attractive colours. The simple truth about California of the south is quite good enough. It is a fact that here is to be found the best yearly climate in the world. Other localities have as good or perhaps a better climate than ours at their best, but certainly none of them have this happy condition the year round as we do on the coast.

A striking peculiarity, and one leading to much confusion, is the great diversity of climate in this country and the different climatic conditions found in even one day's journey.

At the lower stations the various climates all have the peculiar charm of California's equability. This equability is most remarkable. In San Diego, from 1875 to 1901, 9,861 days, there were 9,545 days of temperature not above 80° nor below 40° degrees.

New comers are often bewildered by the many varieties of climate and make statements to far-away friends that add chaos

* Two Health Seekers in Southern California. Edwards and Harraden. J. B. Lippincott Co., Philadelphia.

to confusion in the minds of eastern people. One traveller reports California all sunshine and flowers, another all fog and cold; some complain of the dry desert winds with their exciting electrical conditions, while others dwell upon the excessive humidity, when the probable truth is that the critic has not selected the proper environment and has passed by what he is seeking, which is no doubt within a few short miles.

There is little seasonal change in the extreme southern part of the State. I am accustomed to say to enquirers that our winters resemble September and October in the middle Atlantic States and that our summers are like April and May in the same region. The dividing line betweeen summer and winter is more imaginary than real.

The greatest change in temperature occurs at night, more marked in the interior than on the coast. Solly says that it is a point worth noting that even when the atmosphere has been fairly dry from 11 a.m. to 5 p.m., it is always damp at night. This he has noted at Redlands, one of the most favourably situated of the inland towns.

I wish to call particular attention to the apparent difference between sunshine and shade and midday and midnight. This change is more a subjective sensation than a reality and is true of all semi-tropical localities. It is less marked in California than in Italy, but it always appeals strongly to the new comer, who is surprised at the immediate sense of chill when he enters the shade from the direct rays of the sun.

As the night advances the temperature decreases, and while this change may not cause the mercury to fall many degrees, still it is very noticeable to the individual. This is less marked on the coast in summer and more so at all seasons in the interior.

The weather records, says Solly (page 313), "are not so complete for the night as for the day, but they are sufficiently so to establish the fact, that in spite of the great amount of sunshine during the day in California, the foggy and damp nights and mornings take up a great part of the twenty-four

hours, so that in California, as in the Riviera, the night air is usually damp and frequently saturated with fog.

This same writer continues to say that to those to whom the presence of dry air is not important, California offers many attractions from Monterey to Coronado, and he concludes that it can be said that the coast climate is delightful, equable and healthful.

The days are characterised by a constant sea breeze which blows with astonishing regularity; it is rarely too warm for comfort, like the days at Cape May, Atlantic City, Long Branch or other popular Atlantic coast resorts. Several times during the year the so-called desert spells occur; this is when the land breeze or wind from the desert, many miles in the interior, gains ascendency over the prevailing western or ocean breeze. During this time the thermometer is apt to show a very high registration. Under these conditions I have seen it at San Diego register 98° F., for only a few hours, however, and in the interior reach 110° or 112° F.

The "desert wind" lasts usually only two or three days, but it is extremely disagreeable and exciting, owing to its absolute dryness and peculiar electrical conditions. The nights during this unusual rise in temperature are always cool and pleasant; one never experiences the sleepless, tossing nights of the humid east. These are the only evenings on the coast upon which one may sit out of doors with entire comfort and without sensation of chill; this evening chill is one of the peculiarities of our climate and is somewhat disappointing to the new comer.

With this rather brief outline of the main geographical and climatic peculiarities of Littoral California let us, again briefly, consider the class of patients who will probably be benefited by a residence in this locality. When the existence of phthisis is recognised early and the patient is immediately next to a proper climate, I see often most remarkable restorations to health; a class of people who will derive much benefit here are

those in whom it is impossible to demonstrate the existence of actual disease of the lung (latent and larval tuberculosis), but who are weak, ill-nourished, take cold easily, are subject to attacks of winter cough and bronchitis and whose family-history points strongly to the ultimate consumptive breakdown. These and the early or incipient consumptives should come prepared to remain at least two years—five would be better—and they must be able to procure everything that aids in the promotion and maintenance of the general health. It is madness to come to California in search of health without ample means to supply all comforts and luxuries.

There is usually an early gain in weight and an amelioration of all symptoms; however, if this gain does not at once occur one must not conclude that one is immediately to change location and seek a new climate. Nor is one to sit down in a porch rocker on reaching the selected locality and wait for a miraculous climatic cure. Here, as in all other relations in life, little is to be gained without labour. The climate unaided will produce little, if any, benefit at all.

The only aids which in my hands have produced happy results in restoring health are good food and out-of-door life; I do not mean by this a few hours in an easy chair on the porch, but an out-of-door existence, in many cases for the entire twenty-four hours. Those who come early enough, remain long enough and lead this life, are almost certain to find what they seek. I have records of too many cases of complete and partial recovery under these circumstances, not to speak very positively on the matter and to feel absolutely sure of my statements. Many of these health seekers have become my intimate personal friends, whom I see day by day and whose maladies are cured, arrested or quiescent.

It is, of course, understood that we consider the coast of California suitable for only a minority of tubercular cases; the majority will do best in cool, high, dry climates, but to those to whom a fairly warm, moist climate is suitable, the improve-

ment here will be marked, continuous and satisfactory. I wish, however, to say that I fully endorse the statement of Solly, "The majority of consumptives do better, other things being equal, the further they are removed from the sea, and that they do better in high than in low altitudes, wherever situated."

Scrofulous affections, enlarged glands, the soft, flabby muscles of the strumous individual and the lymphatic or adenoid child, receive a marked benefit from long residence on the coast, combined with sea bathing. During a large portion of the year these baths may be taken in the open air directly in the sea or bay; at other times the very pleasant and attractive bath-houses may be resorted to. There is, I think, a general consensus of opinion in regard to the efficacy of a mild, equable seaside resort with outdoor life and sea bathing for the scrofulous and for cases of very early tuberculosis. The sea air itself, independent of the bathing, seems to be curative.

Those affected with tuberculous disease of the bones can live in the open air, even if confined to bed, or to the use of the various surgical appliances for rest of the parts or correction or modification of deformities. The little sufferers from Pott's disease may be carried out of doors on their cots in the early morning and not brought into the house until afternoon, an inestimable blessing.

Renal disease will be markedly benefited by a residence in this climate; in the *Climatologist*, some years ago, I said that a residence in a suitable locality, while it will not, of course, cure well-marked kidney disease, will at least prolong life to a degree far beyond the natural expectancy. The constant skin activity, much of which is manifested as insensible perspiration, lowers arterial tension and depletes in a most beneficial manner, relieving the over-taxed renal circulation and the diseased parenchyma. From sea-level to 2,000 feet we can promise the patient suffering from chronic renal disorder marked prolongation of life in comparative comfort; and, if the change be made soon enough, when the connective tissue is yet

embryonic, it is but reasonable to suppose that, with decreased tension and active skin, freedom from intercurrent renal congestion and a constant outdoor life, the disease may be arrested or removed.

Wilson and Loomis, in their paper read before this Association in 1889, state that there is reason to believe that low temperature and high altitudes are unfavourable, whereas equability and warmth are favourable influences.

Those affected with the various urinary diatheses, so-called and other troubles of kindred nature, will find help in prolonged residence here; cystitis, so often an attendant on advanced years and so apt to be aggravated by damp, changeable weather, will be markedly benefited by the warm, equable coast climate. Insomnia in the young or old will find relief in the same region.

I have elsewhere said that advancing years and old age may be robbed of many concomitant infirmities by residence in this locality; they cannot with impunity change from a low to a high altitude, more particularly if they suffer from chronic pulmonary disease, bronchitis, bronchiectasis, fibroid phthisis or the like. A dilated fatty heart is safer at sea-level. On the whole, a marine climate is preferable for old people, and if it be warm and equable, so much the better.

This country is a veritable paradise for the growing child. There is no period during the entire year when it is necessary to house the little ones. There are no badly ventilated, overcrowded or overheated rooms. The zymotic diseases are usually not at all prevalent; they are mild, run a very favourable course, and are generally followed by complete recovery. The scrofulous child lives under the most favourable conditions to combat the inherited taint.

DISCUSSION.

Dr. PHILLIPS: Dr. Solly has asked me to tell him why we have fogs here more frequently than on the Italian shores. I am afraid Dr. Solly will say that I am unsatisfactory in my answer, when I confess that I do not know, and follow that by saying that I can frame an expression of my ignorance, however, in such words as to make it seem that I do know. If I say it is a matter of air drainage, and an intermixture of varying air currents that does not happen on the Italian coast because of the different topography of the country, it sounds as if I had said something, but if any of you know any more about it now than you did before you are wise gentlemen. The fog formation of the Pacific Coast is peculiar and is one of the most interesting studies to the meteorologists. Professor McAdie, of San Francisco, has been giving it his attention for several years and he has made quite a number of valuable reports on that subject. He is still at work upon it, he is perhaps the best qualified man in the world to speak on the subject and yet he confesses that he does not know anything about it. I think his idea is, that it is probably a radiation phenomenon due to the air cooling off more rapidly at night than the water surface. In meteorology, as elsewhere, when we want an explanation and have not a better one, we fall back on the supposition that perhaps there is an electrical element at work and so perhaps there is in fog formation. One statement that Dr. Edwards made, when he perhaps forgot himself and returned to the old California habits, I do not think he meant that it was warmer here on Christmas day than on July 4. I want to add to what has been said by Dr. Solly and others that I am glad to hear the Californians getting truthful about their climate.

Dr. BOWDITCH: I am grateful to these gentlemen for an honest expression of their convictions as the result of long experience in this region. You will pardon my thrumming upon one string, knowing my great interest in the sanatorium treatment of consumption. I was particularly interested in the paper just read by Dr. Lindley, and in what he has said about the beautiful sanatorium at Idyllwild. One point I wish specially to emphasise this morning is the importance of fresh air in the treatment of tuberculosis. It needs emphasis at this time. Those of you who do not know what we are doing in Massachusetts will be perhaps astonished to know what can be done even in that harsh, changeable climate. In the sanatoria at Rutland and Sharon the windows are not closed even in the worst weather. I do not mean to say that we do not close them on the side of the house upon which a heavy wind, rain or snow storm is blowing, but even at such times the windows of the other sides are kept open. I know the improvement that comes from enforcing this rule rigidly. In my first few years of sanatorium work at Sharon, I did not enforce that rule, and in the evenings the patients would sit in the parlours with most of the windows closed, and occasionally I came in to find a more or less confined atmosphere, and, to use an unpleasant expression, to note the smell of human beings which I

hated to find. Two or more years ago I decided to enforce the fresh-air treatment there more rigidly. I trembled at first because I thought it possible that in our severe New England climate some of those cases with a endency perhaps to attacks of bronchitis might suffer from it ; but I decided that such cases must be advised to try the same methods in warmer climates. They proved to be exceptions, however, and the others forged ahead in their improvement. This method has been followed literally now, and in going over the results of the last two years, looking at them in the most conservative way, I find that the percentage of arrested cases has largely increased. If we can do that in New England, think what you can do here in California. Therefore, enforce these rules rigidly, or you will fail to get the best results.

I have never been one of those who, from their enthusiasm over the sanatoria established in the East, have held the opinion that it was no longer necessary to send patients away from home. I have held that, although we can do so much there for the hundreds who cannot leave the East for various reasons, you can accomplish much better results in your more salubrious climate. So I beg of those who will aid in establishing similar sanatoria to this one at Idyllwild that you enforce this open-air method rigorously, and I believe you will thus accomplish wonderful results. It has been the greatest gratification to me to see Idyllwild, and I take off my hat to those gentlemen who are giving their time and money to make such an institution here. I hear, moreover, with the greatest pleasure that establishments are to be founded soon near the larger towns where the hopelessly sick may be received. This work is just as important as having places for the incipient cases. As I have said often and often before, these places are centres of education, and the people taken in there are taught what to do and what not to do, and they go home to teach their families and friends the laws of proper hygiene. A few generations will show the benefit of these institutions. I trust you will all put your shoulders to the wheel to push along this good work. May the day soon come also when you will secure the establishment here of state sanatoria as they are doing now in some of the Eastern States, following the example of Massachusetts.

Dr. PHILLIPS: In the statistics given by Dr. Lindley I was somewhat interested in his report on the humidity. As I recall the figures, the humidity increased from the morning to mid-day very rapidly; that is, the relative humidity. So far as my knowledge goes that would be something of an anomaly. Relative humidity declines from morning to the hottest part of the day and then gradually increases as the temperature falls, until it reaches its maximum at the point of minimum temperature, about an hour before sunrise. I would suggest to Dr. Lindley that he secure a standard hygrometer and compare his instrument with that, or better, that he procure a wet and a dry bulb thermometer for such work, because all hygrometers that depend upon the hygroscopic action of organic elements are subject to serious errors. These readings given by Dr. Lindley suggest to me that his hygrometer is giving a temperature effect rather than a hygrometric effect.

Dr. ORME: I was very much pleased to listen to the papers read this morning. It had been my purpose to prepare a paper for this meeting of the Association on some of the peculiarities of Southern California Climates, but was unavoidably prevented.

During my residence here of more than thirty years, I have had occasion to write several papers on this and allied topics. Our local climate and how to live in it is a most difficult question to consider satisfactorily.

Dr. Solly struck the key note last night when he said that *change* was an important feature to invalids going anywhere; and Dr. Bowditch has emphasised an equally valuable truth in insisting upon the importance at all times of fresh air.

I came here broken down in health from overwork and repeated attacks of bronchial pneumonia, with the probability of an extension of but a few years at most, yet, as the result of the change, much outdoor life, and favourable salubrious climatic environment, I have been constantly active and continue so to-day.

San Diego has even more uniformity and less change in the twenty-four hours than Los Angeles, and Dr. Edwards, with the many good points in his admirable paper, is emphatically correct when he insists that one should wear the same weight of garments all the year round. Many criticisms on this climate should rather be on the mode of dress, and the manner of living of new comers. This is a cool rather than a warm climate, and one should dress for the lowest temperature of the twenty-four hours.

Dr. SOLLY: I need scarcely voice the commendation of the papers we have heard, and which have been so moderate and so truthful. One of the most interesting points to me was the comparison of the air here with that of the Riviera; and this a very practical point, because many Americans have been going abroad who should have come here and, to my mind, would have been benefited more largely. I should like to have from Dr. Phillips an explanation as to why there is more fog here than on the European Riviera. It is a drawback to some invalids and perhaps an advantage to others. On the European Riviera I have experienced difficulty in sitting out of doors with comfort after sundown, but there has not been so much fog. Dr. Edwards spoke of the coldness of the air north of San Diego. I think the records bear out the fact that it is not so cold, and that the wind is not so trying, as on the European Riviera, where this condition is particularly trying. I believe that this Riviera of California is ahead of the European Riviera. Now the point that Dr. Edwards made about this being an all the year around climate, I think, is undoubtedly true, and such a remark would not apply to the European Riviera. Not many people can stay there all the year, for it is hot and disagreeable at times. I do not think he is right, however, in saying that Southern California has the only all the year around climate, because we claim that we have such a one in Colorado; but that is another story and I only enter a protest here. I was very much interested in hearing Dr. Edwards speak of the benefit of this climate on scrofulous cases. It seems to me

you must have here, particularly about San Diego, a good climate for those cases. The matter of kidney diseases, too, I was glad to hear mentioned. I think we ought to send more kidney cases down here, perhaps, than we do. We do not know quite enough about the physiology or pathology of kidney diseases, nor about the elimination from the skin, other organs, and to what extent they relieve the kidneys. I made some study of that point some years ago, but found difficulties in the way of measuring in the laboratories the elimination from the lungs, skin, bowels and kidneys. Can Dr. Edwards tell us whether the elimination of urea by the breath was very marked in his case as well as the elimination by the skin? The crystallisation, as he describes it in that case, is rather surprising in the atmosphere of San Diego. We expect it in the high dry districts, and still more in the desert regions. To me, the ideal climate for kidney affections, speaking in a general way, would be a desert climate like that about Phœnix; and my experience has been rather favourable, although that climate does not favour all cases, and I know not exactly why. That high climates are not suitable to all kidney cases is probably due to the fact that sudden changes of temperature bring on greater risks, which you escape down here. I would like to have heard something of the effect of this climate upon rheumatism and gout. I have heard the statement that old people do particularly well in this region, and I believe it is undoubtedly true, for we find that our elderly men from Colorado come down to California with great benefit, and I have no doubt that before very long, perhaps only three or four years Dr. Hart and I will be coming down to Los Angeles.

Dr. Sewall: I would like to contribute my note of admiration for the judicial method adopted by Dr. Edwards in his paper. It is particularly hard for a dweller at a health resort to speak with absolute truthfulness of the climate in which he lives. It is a feeling of gratitude for the benefits he has derived that usually leads him to praise it, and he has to be a chronic kicker by nature if he would always tell the truth about it and expose the dark side. I am not sure that Dr. Edwards belongs to that group, but I rather suspect him. In Colorado we have gone about the matter in a rather brutal manner, and have exposed dangers to which health resorts for the tuberculous are subject by showing in the report of our Medical Association of last year that tuberculosis is contracted right in Colorado. This year's meeting will show how tuberculosis can be prevented in Colorado. I believe that laymen throughout the country, wherever that report was sent, jumped to the conclusion that Colorado was a hot-bed of tuberculosis. Perhaps you do not know that we are told outside of this State that California is a hot-bed of this disease, and that your State Board of Health is considering a quarantine against it. Your plain statements this morning, however, will not be misunderstood by those of us familiar with the subject, and their honesty will be heartily appreciated.

Dr. Fisk: A year ago someone coined a word that he thought hit my case and called me a Coloradofornian and Dr. Edwards has referred to me as being responsible for having helped to bring the Society to California. I

felt that as students of climate, we wanted to know something about California and we wanted to know it as it is, and not as it was said to be; we wanted to see for ourselves. Of course, in a brief visit like this, we cannot see California. There are certain things we must recognise; for instance, at sea level you do not have the effects of elevation, and you do not have the effects that you get at a distance from large bodies of water. Now in Colorado, by way of comparison only, we are 500 miles from the Missouri River and the climate is dry. In the winter it is not unusual for the nails to crack and the skin to get horny, so that I myself have taken a pair of scissors and cut the skin off my fingers. You do not have that down here, it is impossible at sea level to have such dryness. We are told that you need water for your olive trees, your orange groves and other fruits, that things grow under water, perhaps the bacilli grow under water also. But there are other diseases besides pulmonary tuberculosis, and this is not a Society for the consideration of that subject alone.

Dr. Edwards says this is a great climate for renal affections. There are many people in the world who have such diseases, they will do well here and we are glad to know it. There are persons who have nervous affections and we are glad to know that they are benefited here. Rheumatism has not been touched upon, but it is question whether sea-food and out-door life at sea level would not help them. There are all sorts of climates and they haven't a monopoly at Boston, in Colorado, nor in Los Angeles. But we want to know what conditions of climate prevail in each of these places, and it is by meeting around that we learn just those things.

This is perhaps a moist climate. I know that on February 9, a year ago we sat awaiting the arrival of a noted violinist for an hour and a quarter because of a wash-out on the railway between here and San Diego, and that, too, is such a dry climate. I know that only a few mornings ago, up at Riverside, a member of this Association was going around with an umbrella because he thought it was going to rain. I notice that though we have been sitting here all the morning the sun only came out a few minutes ago, but it would be called a clear day. As we went to the sea shore yesterday afternoon we could see fog banks in the sky and it looked as though a shower was coming up. It is stated in this pamphlet which I hold (Colorado weather, 1901), that the relative humidity here ranges from 65 to 90 per cent. Relative humidity doesn't give the actual number of grains of moisture in a cubic foot of air and the air can hold more moisture at sea level than at a high altitude. We must bear these things in mind, and if it is not a place for pulmonary tuberculosis it is still a great place for other affections.

Dr. SOLLY: I do not like Dr. Lindley's paper to pass without my adding a word to the sentiments expressed by Dr. Bowditch endorsing the noble enterprise you have undertaken here in Southern California. I congratulate the district upon coming into its own. Ten years ago I looked upon those mountains and found them tenanted only by a few camping parties and I am delighted now to note the change. I hope many of those who were

suffering from nervous irritations and who need a change of climate, will be able to go up to Idyllwild and enjoy the advantages to be derived there.

Dr. EDWARDS: I wish to add just a few words on the subject of rheumatism. My paper had to be limited, of course, and I drew the line there. The Society may know that I have been engaged upon a work in which this question came up. I wrote to many of the distinguished physicians of the country, and I asked Dr. Osler, for instance, whether he had the nerve to classify rheumatism as an infectious disease. He replied that he had, but not in print. I wrote to others, to Dr. Barlow and Dr. Cheadle, of London, and the latter came out with a positive statement that it is. I have for many years believed it to be so, and have brought it out in my recent work. On that account I have hesitated to say what my opinion was about the benefit of the climate here upon rheumatism. Dr. Curtin knows the condition in which I left Philadelphia some years ago. I had been a subject of rheumatism, had endo-pericarditis, and Osler, Pepper and others believed I had a perforation of the colon as the result of intestinal rheumatism. I came here fifteen years ago, and you can see how well I am. Many newcomers here find that they have an attack of rheumatism shortly after arrival, and some rheumatics do well by changing from the coast to higher altitudes. My practice is among a rich, indolent class that present rheumatism in all its forms, and when they leave the coast, take up a more rigorous diet and learn that they have legs to walk upon, the condition passes off.

What I meant to say about the temperature of Christmas day had reference to sensible temperature. The thermometer may register lower but we feel colder at Coronado in April, May and June than we do in January and February. And in spite of these scientific gentlemen with their exact thermometer records, we must consider the feelings of the individual as affected by the temperature.

The PRESIDENT: I am sure we are all indebted for the feast of reason that has been presented this morning, and I know I voice the sentiments of the Association in thanking the gentlemen who have prepared these papers, and especially for the care they have taken to provide us with exact information.

THE ACTION OF STRYCHNIA ON THE HEART AND THE EVIL OF OVERDOSAGE.

BY ROLAND G. CURTIN, M.D.

It has been my intention for some time to present a paper on the use of strychnia in cardiac conditions before this Association; and last year, when Dr. Jacobi announced his intention of reviewing this subject at Niagara Falls, I arranged my material with the idea of using it in the discussion of his article. When the latter was read by title, I determined to present my views at this meeting, in order that the subject might be discussed by the members of our Association. I have purposely avoided reading Dr. Jacobi's paper, that I might be better able to express my personal views without being influenced by any stand which such an eminent authority might have deemed it advisable to take.

Before entering into any discussion, I wish to state that I am not in favour of using such large doses of strychnia in advanced cardiac disease as are often employed in America at the present time. I realise that I am almost alone in my opinion regarding the administration of heroic doses of this drug as a heart tonic—not that I wish to deny the usefulness of rational doses of strychnia in certain conditions of cardiac weakness; but I wish to call attention more particularly to the abuse of the remedy. It would be folly to condemn unreservedly its use in tonic doses, in selected cases; or in full doses, in emergencies, such as occur in the acute infectious diseases unaccompanied by macroscopical changes in the myo-

cardium or endocardium, or to help tide over such crises as occur in primary shock or operative shock. Clinical evidence is too familiar to all of you for me to deny its efficacy in such cases. I do, however, take issue with those, especially of the younger school, who indiscriminately give doses of $\frac{1}{5}$ of a grain or more in the twenty-four hours; for I feel convinced that under such treatment I fail to see cases recover which formerly, under more rational treatment, were restored to greater or lesser degrees of usefulness.

Laboratory research and clinical observations have established the following physiological actions of strychnia, in so far as it affects the cardio-vascular apparatus:—

Physiological doses produce (1) vaso-motor stimulation, resulting in a rise of blood pressure; and (2) probably stimulate directly the heart-muscle and also its peripheral inhibitory apparatus.

Toxic doses cause (1) lowered functional activity of the motor nerve-trunks, by producing exhaustion and by directly paralytic influence; and (2) paralysis of the peripheral vagus, and depression of the heart and vaso-motor system.

La Housse, a learned Professor of Belgium, from experiments on dogs, demonstrates that sulphate of strychnia, in large or small doses, causes slowing of the heart, without any preliminary acceleration, even when the heart has previously been atropinised. The drug paralyses, from the outset, the intra-cardiac motor centres; and also (though only in large doses) the terminal fibres of the vagus, probably without previously exciting them. The slowing of the heart is not due, as Mayer states, to excitation of the moderating bulbar centre; but, in La Housse's opinion, to paralysis of the intra-cardiac motor centres.

The above statements are self-explanatory, and need not be commented upon further than to say that the results vary somewhat, depending upon the size of the dose given. For instance, the primary stimulation of the vaso-motor centres is

soon followed by a fall of arterial pressure, caused by vaso-motor palsy; and if large doses are given, an immediate fall is produced, by depression of the vaso-motor centres, without their being primarily stimulated.

You will observe, also, that I have given the physiological actions of toxic doses, which are directly opposite to those that we desire to produce. I have mentioned these because of the idiosyncrasy some persons have for doses which, in others, would cause no unfavourable symptoms.

Within the past four years I have been called to see several patients, two of them physicians, who had been thrown into convulsions by such treatment. One of these physicians said, "Doctor, I think the trouble is too——much strychnia." I thought so too; for even slight pressure on the bed caused him to jump, and whenever he attempted to talk he had a spasm of the diaphragm. I suggested, at the consultation, that the question to be decided was not what should be given, but what should be taken away; and advised giving the drug in much smaller doses. One of the consultants, an old physician, afterward told me that it was one of the most successful consultations he had ever attended.

To refer again to the physiological actions of strychnia, and to apply these facts to a given case, suppose a person to be suffering from shock. While the pathology of the condition is unknown, we realise that vaso-motor paresis is one of its most apparent manifestations. Strychnia here meets the indications by quickly stimulating the cardio-vascular system, but, at the same time, other means are employed to produce a reaction. So, in the acute infections, when the circulation is suffering from the effects of a systemic toxæmia, the drug may be given with benefit until the offending toxin has been neutralised, either by natural processes or by remedial measures. On the other hand, given a heart crippled by organic disease, the dominant action of the drug—that is, vaso-motor stimulation—cannot be made use of; and its direct effect upon the heart is so slight that it

seems irrational to employ it in place of such remedies as are known to act more beneficially upon the myocardium and its controlling nerves.

A short time since, I read a report of some experiments to determine the action of strychnia upon muscles. One of these experiments I remember in particular. The forearm of a strong, healthy man was tested with a dynamometer, and it was found that he could squeeze a certain number of pounds and hold it for three-quarters of a minute. He was then given strychnia up to its therapeutic limit, and tested again. This time, the dynamometer suddenly registered half a pound more, but the man could not hold the instrument, for the hand immediately relaxed. This is not the character of the contraction which we desire to produce in the cardiac muscle. It increases the strength of the heart-grasp, so to speak; but the grasp does not hold long enough to fully expel the blood.

Again, strychnia may be compared, in its action, with electricity. It is a stimulant; and too much stimulation, either from strychnia or from electricity, is followed by weakness from exhaustion. In the accounts of the last six-days' pedestrian race held in New York City, in which some of the best walkers in the country were entered, mention is made of the fact that strychnia tablets were generally used as a stimulant. On Friday, a day and a half before the end of the race, the leader was one hundred miles behind the record time. This, it seems to me, is what might have been expected; exhaustion following irrational stimulation.

In observing at the bedside the action of large doses of strychnia, a few facts have impressed themselves upon my mind, particularly the quick, snappy contraction produced. It can readily be appreciated that, in forcing fluid out of an elastic bag, the latter is under much less strain from a slow, steady pressure applied to it, than it would be were it given a short, quick squeeze; and the result would be a steadier stream flowing from it.

To use another simile, a horse is encouraged to pull a heavy load to the top of a hill by a sharp application of the whip. At the top of the hill, however, the animal must rest; and the driver knows that if he keeps on applying the whip and straining his horse, the animal will exhaust its strength. We can imagine a similar condition of affairs when a heart is stimulated to the limit with large doses of strychnia; it cannot rest, but must go on.

In protesting against the abuse of strychnia, the question may properly be asked, what drugs are to be given in place of it? Experience has led me to place the most dependence upon digitalis and alcohol—digitalis because of its remote, as well as of its immediate effects; that is, it will, in time, because of its beneficial action upon the cardiac muscle, tend to remove the cause of the symptoms for the relief of which the drug was primarily given—alcohol, because, in addition to its being a diffusible stimulant to the circulation, it is, I believe (many positive statements to the contrary, notwithstanding) a valuable tissue food. Strychnia fulfils neither of these important offices. It cannot be classed as a food; it will not cause the slow, full, satisfactory ventricular contraction observed after the dose of digitalis.

Besides these two drugs, dependence may be placed upon nitro-glycerine, citrate of caffeine, cactus grandiflora, strophanthus, ammonia, and atropine. With these remedies selected to meet individual cases, and combined in proper proportions, I feel sure that we can look for much more favourable results than can be obtained by giving large doses of strychnia.

While talking, one day, to Dr. Sansom, I asked him why it was that, although there were a number of bad heart cases in the London Hospital, none of them were getting large doses of strychnia. "Because," he said, "I consider it bad therapeutics. Strychnia in large doses, is of no benefit to the heart, and will not assist it, when in a crippled condition, to do its work." I understand that Houchard, of Paris, who also stands high as a cardiologist, is of the same opinion.

The most important factor, however, that has led me to the conclusions which I have tried to make plain in this paper, is this: Never have I seen a case of marked depression of the heart from chronic disease in an elderly person, in which large doses of strychnia were given and the patient survived. On the other hand, I have seen many who got as nearly well as is possible in such cases, under the proper administration of alcohol, digitalis, and other cardiac tonics.

DISCUSSION.

Dr. ARNOLD: I am very glad to hear this paper by Dr. Curtin because I agree with him and the subject is important. It seems to me that strychnia, as it is commonly used to-day, might be classed almost as one of the medical fads. It is especially useful to have a person of Dr. Curtin's experience call our attention to the dangers of such practice. I have nothing in detail to add to what he has said, but it occurs to me that it opens up a little broader question in cardio-therapeutics. We are too apt to consider the effect of drugs on the heart alone, whereas one of the greatest problems we have to deal with in this connection is the relation of the peripheral circulation to the power of the heart. Whatever the drug that is used, strychnia, digitalis, or others, this problem must always receive careful consideration in cardio-therapeutics.

Dr. BOWDITCH: I confess it was a relief to me to find that Dr. Curtin had taken this position. I was afraid from the title of the paper that he was going to laud the large doses which are frequently used. I have seen in the hospital many cases in which I thought some of the most unpleasant symptoms were largely due to over-dosage with strychnia, and the subsequent results upon leaving it off have proved it to my mind. In regard to the use of alcohol, &c., I shall take issue with Dr. Curtin, for I have come to the conclusion that the more cautious we are in the way of administration of drugs or alcohol in pneumonia with abnormal heart symptoms, the better it will be for the patient. We had an interesting discussion lately in Boston between Drs. Cutler, Shattuck, and others, the first thinking that alcohol should never be used at all, the latter thinking it should be used in small doses, much smaller than formerly, while others favoured its liberal use. The discussion was somewhat disquieting as showing the difference of opinion among eminent men. The general opinion of the younger men, however, was that stimulation in any form was something to be greatly modified from the usual custom of past years.

Dr. NAMMACK: I am quite in accord with Dr. Curtin's old friend, who believed that there was "too blank much strychnia" used. At the same time, I know of no drug that I would be more loath to part with than

strychnine. I think a great deal of abuse of it comes from the fact that some of us have a misconception of what it is or what it does. I have been using it in the cases in which I believed it to be indicated, with the idea that it is not a heart tonic *per se*, but believe that whatever effect it has upon the heart is obtained through the nervous apparatus of the heart, that it is a nerve tonic, and should be given in small doses frequently repeated. We were formerly taught in New York, and I believe the teaching is the same now, that in the use of a pure neurotic—the effect of one dose is exhausted in the system in a short time. The effect of strychnia, I think, lasts between two and three hours, and therefore in such a condition as acute pneumonia, I do not think that one-fifth of a grain in twenty-four hours is too much, provided it be divided into a sufficient number of small doses. In my own practice the doses are given at two-hourly intervals.

I know of no better way to describe the condition we are speaking of than to use the simile suggested by Dr. Curtin's distinguished fellow townsman, Dr. Hare, who described the heart in pneumonia as comparable to a locomotive endeavouring to drive its wheels along a slippery track. Adding to the steam in the boiler will only help to rack out the machine in ineffectual efforts to turn the wheels, and the thing to do is to put sand on the track, that is, to increase the peripheral resistance and to give the heart something to work against. In cardio-therapeutics, I do not use strychnine with the view of strengthening the labouring heart which results from valvular disease. But in cases of myocarditis small doses of strychnine will have the effect of steadying the heart. Dr. Arnold has also brought up the question of the recognition of peripheral resistance. We must look to the capillary vessels for a decided effect when we have a labouring heart, no matter what its cause. If I were debarred the use of strychnine in pneumonia, therefore, I would turn to that other group of remedies to which Dr. Curtin has alluded, alcohol, the nitrites, &c. Digitalis is again adding steam to the boiler, without looking after the wheels of the machine; it is like putting the spur to a willing horse to induce him to go over an impassable wall. The effect is to make him dash his brains out against that wall.

Dr. SOLLY: I would like to say a few words in commendation of Dr. Curtin's paper. I am only sorry it was so short, for it is a very small section of a very large subject. I agree with him with regard to the great abuse of strychnine and with Dr. Nammack as to the moderate use of it in small doses extending over twenty-four hours. What Dr. Bowditch said about using very little drugs for the heart is, I think, very true; rest in bed and milk will do a great deal for the heart, but of course it is not necessary to consider here when to use digitalis and when to use strychnine.

I think in Colorado, where we so often see heart cases complicated with pulmonary diseases, we are perhaps called upon to use strychnine a little more frequently than you who practise at sea level. It does seem to act admirably in cases where the pulmonary organs are interfering with the action of the heart, if it be used in small doses, while if it be used in large doses it merely adds fuel to the flames.

CLIMATES AND HEALTH RESORTS IN THE DOMINION OF CANADA.

BY GUY HINSDALE, M.D.
PHILADELPHIA.

THE Canadian provinces which stretch from Newfoundland and the Gulf of St. Lawrence on the east, to Lake Superior and Manitoba on the west, present wide differences in respect to climate. Throughout this region there is, as a rule, a short summer followed by a rigorous winter. Although Quebec is nearer the ocean, Ontario is the more favourably situated, much of its area stretching below 45° parallel. Toronto is upon the same degree of latitude as Portland, Maine, and the extreme southern limit of Ontario is upon the shore of Lake Erie. The great lakes exert a strong influence on the climate of Ontario, insuring less severe extremes of temperature and a more abundant rainfall than in Manitoba, Assiniboia, Saskatchewan, Athabasca, and Alberta.

The low temperatures recorded in winter in Ontario are comparable with those obtained in Michigan and the northern portions of New York and New England. The winters are chracterised by steady cold, a heavy snowfall, and at least three months of sleighing. In Quebec the snow begins to fall in November and lasts for about five months.

The lower lake region and the St. Lawrence valley are the most frequent paths of storms. Hence this region experiences a large percentage of cloudy days and a comparatively heavy precipitation. Tornadoes are rare but may occur in the St.

Lawrence Valley during the summer months.* Canadian winters, while intensely cold, are not attended with the discomfort that might be expected from a consideration of temperature records alone. The dry, bracing atmosphere renders the coldest days frequently the most enjoyable and invigorating. The freedom of the interior districts from the easterly winds and damp fogs of the coast, as well as from the sharp changes of weather so common in the United States, robs the winter of many of its terrors.

Many visit Montreal in midwinter when gay ice carnivals draw thither large numbers of people from Canada and the United States. At this time an abundance of snow and ice is essential to pleasure, and the supply is ample. Snow in Canada protects the grain and facilitates transportation. It is indeed indispensable to the great lumber interests, and renders the remote regions in the north accessible. The rainfall increases from the interior to the coast. The highest average of yearly rainfall is at Cape Breton, where it reaches 55 inches. Halifax has 43 inches; Sydney, 49; Montreal, 27; Quebec, 19; Ontario, Toronto, 29; Barrie and Peterboro, 20; Winnipeg, Manitoba, 16; and Spence's Bridge, in British Columbia, only 4 inches.

Snow varies greatly in amount, but averages 115 inches in a year in Quebec, 112 inches at Prince Edward Island, 62 inches in Manitoba, and 33 inches at Spence's Bridge, British Columbia. It usually first begins to fall in October throughout the interior provinces, but occurs somewhat later on the coast.

The winters of north-west, upon the whole, are agreeable. The moccasin is dry and comfortable throughout, and no thaw, strictly speaking, takes place till spring, no matter how mild

* A tornado passed through the towns of Finch, Winchester and Chesterville, Ontario, (lat. 45 N., long. 75 N.) on July 18, 1902, killing three persons, injuring ten and destroying 200,000 dols. worth of property. Its path was eighty rods in width; it occurred after the passage of an area of low pressure north of Montreal.

the weather may be. The snow, though shallow, wears well and differs greatly from eastern snow. Its flake is dry and hard and its gritty consistence resembles white slippery sand more than anything else. Generally speaking, the farther west the shallower the snow until the rocky mountains are reached. Heavy snow-falls occur in the mountains and especially about Glacier and throughout the Selkirks.

MEAN TEMPERATURE FOR EACH MONTH AND FOR THE YEAR IN THE SEVERAL PROVINCES AND STATIONS IN CANADA.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Ontario ...	19·3	20·2	26·7	42·6	54·4	65·6	69·8	68·1	58·6	47·4	33·0	20·5	43·8
Quebec ...	13·5	15·9	25·3	41·8	54·9	66·0	70·2	68·1	58·7	47	33·1	17·1	42·6
New Brunswick	16·1	18·1	26·4	37·6	46·4	57·7	62·8	61·4	54·2	45·1	32·3	19·8	39·9
Nova Scotia ...	22·3	21·2	26·7	35·9	44·6	56·6	63·3	62·9	56·4	48·2	36·5	25·5	41·7
P. E. Island ...	20·5	14·7	27·6	33·1	46·2	54·0	64·3	62·7	57·2	49·4	32·7	22·9	40·5
Manitoba ...	2·9	3·0	9·0	30·2	51·2	63·6	65·9	64·8	51·3	40	14·6	0·6	32·6
Brit. Columbia	22·8	28·8	40·8	51·9	59·9	64·5	72·2	70·7	61·4	49·3	30	24·5	48·1
Newfoundland	25·6	22·7	28·7	33·3	43·0	50·7	60·3	60·1	55·8	49·6	38	28·9	41·4
Toronto ...	22·9	22·9	29·3	41·0	51·7	61·7	67·4	66·2	58·1	45·9	36·2	25·7	44·1
Montreal ...	16·8	18·6	26·9	43·5	57·2	66·4	72·2	69·8	60·8	47·5	33·6	18·9	44·3
St. John, N.B.	18·4	21·4	27·8	38·2	46·7	54·7	59·7	59·5	54·5	45·6	35·7	22·8	40·3
Halifax ...	22·9	23·7	28·1	38·1	47·4	59·7	63·5	63·3	57·4	48·3	37·8	25·8	43·1

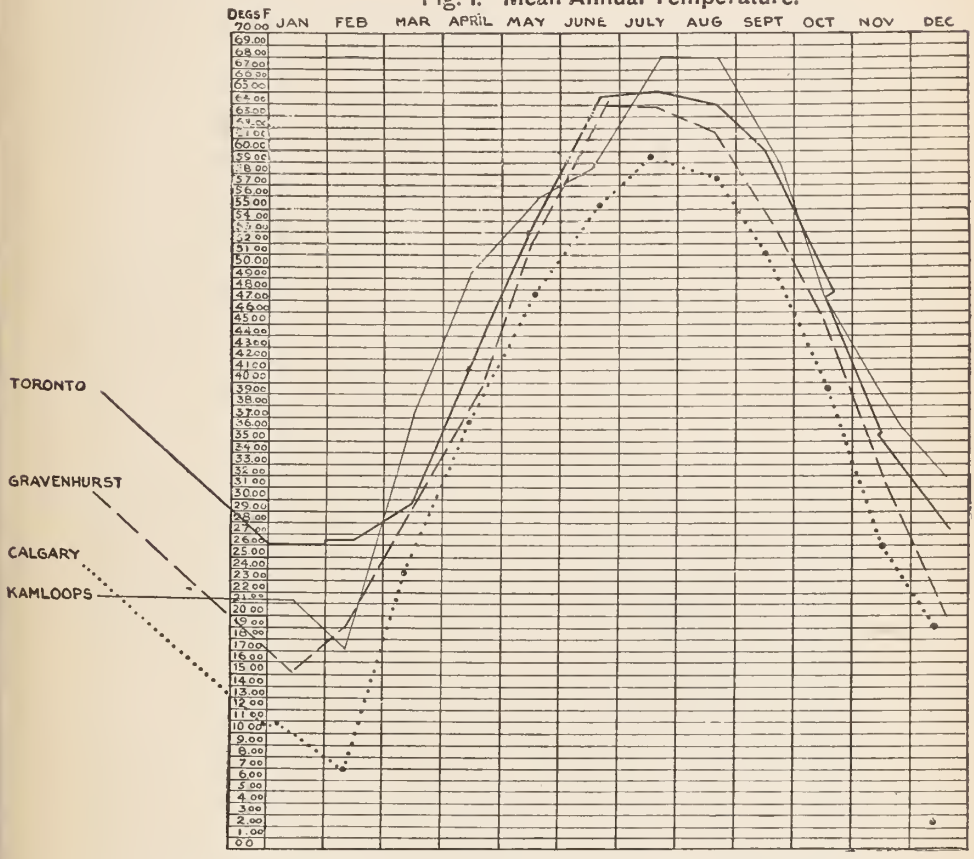
The average of yearly maximum temperatures in Ontario is from 89 to 96°; in Quebec, 90 to 96°; New Brunswick, 79 to 88°; Nova Scotia and Prince Edward Island, 85 to 88°; Manitoba, Alberta, and British Columbia, 96 to 97° F.

The lowest average of yearly records in Ontario are Goderich, 8°; Toronto, 12°; Barrie and Peterborough, 26°; Pembroke, 37°. In Quebec, 23°; Montreal, 17°. In St. John, N.B., 10°. In Nova Scotia, 8 to 9°.

NEWFOUNDLAND.—This large island lies east of Canada, between 47 and 52° north latitude. It is the nearest point to Europe on the American coast. Its southern extremity, Cape Race, is in the same latitude with northern Michigan and Seattle, Washington. St. John's, the principal city, is situated on a peninsula, with a well-protected harbour, from which

steamers leave for Quebec, New York, Baltimore, and for the coast of Labrador. The cliffs rise to a height of 500 feet, affording the most picturesque scenery. There are various interesting trips by water from St. John's.

Fig. 1. Mean Annual Temperature.



Forest Climates, the Prairie Climate of the North-west Plateau, and the Inland Climate of British Columbia.

The climate of Newfoundland is cold and damp, and unsuitable for persons unaccustomed to the bleak shores of the north-eastern coast. The mean annual temperature is 41·4° F. The mean monthly temperatures (Fahrenheit) beginning with

Fig. II. Mean Daily Range of Temperature.

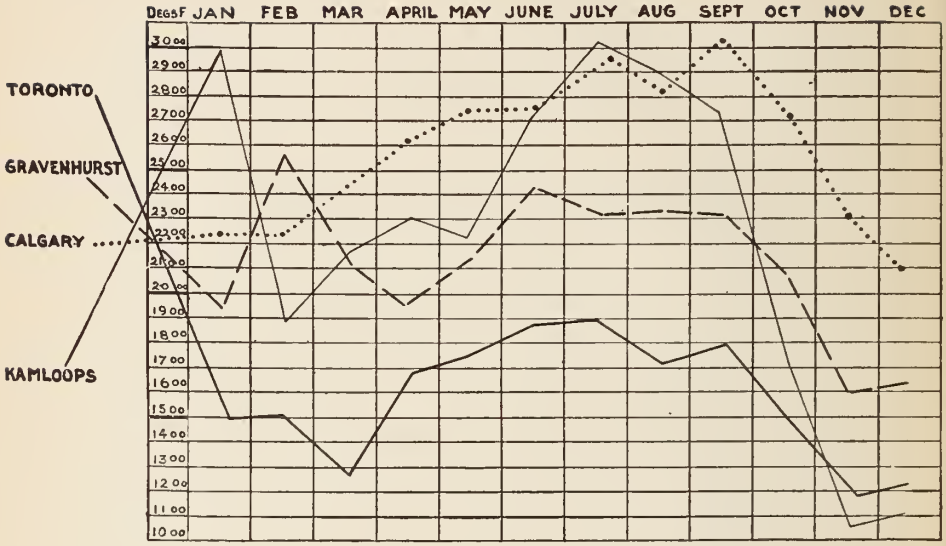
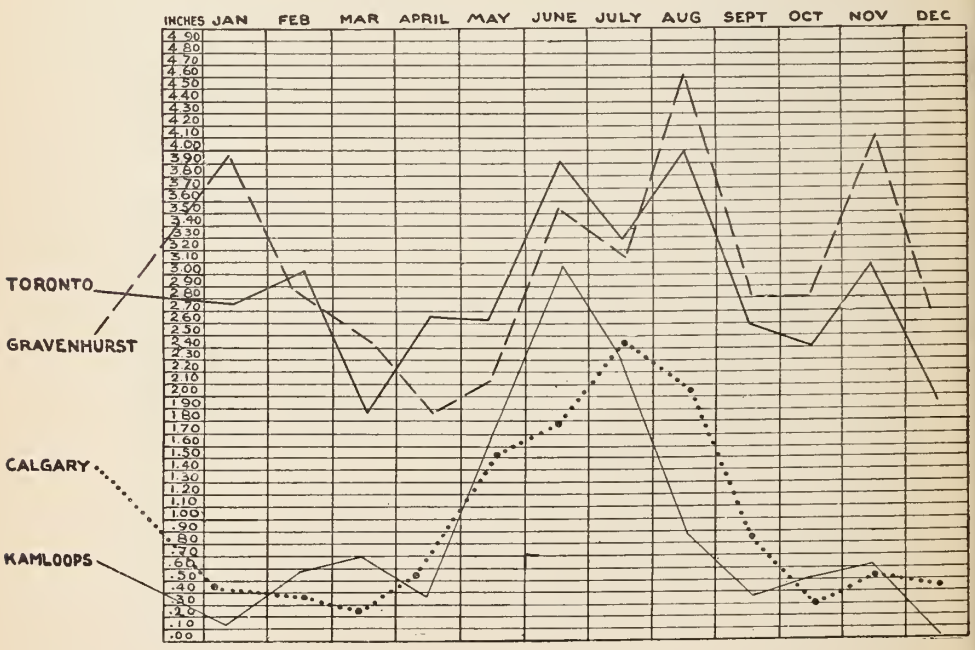


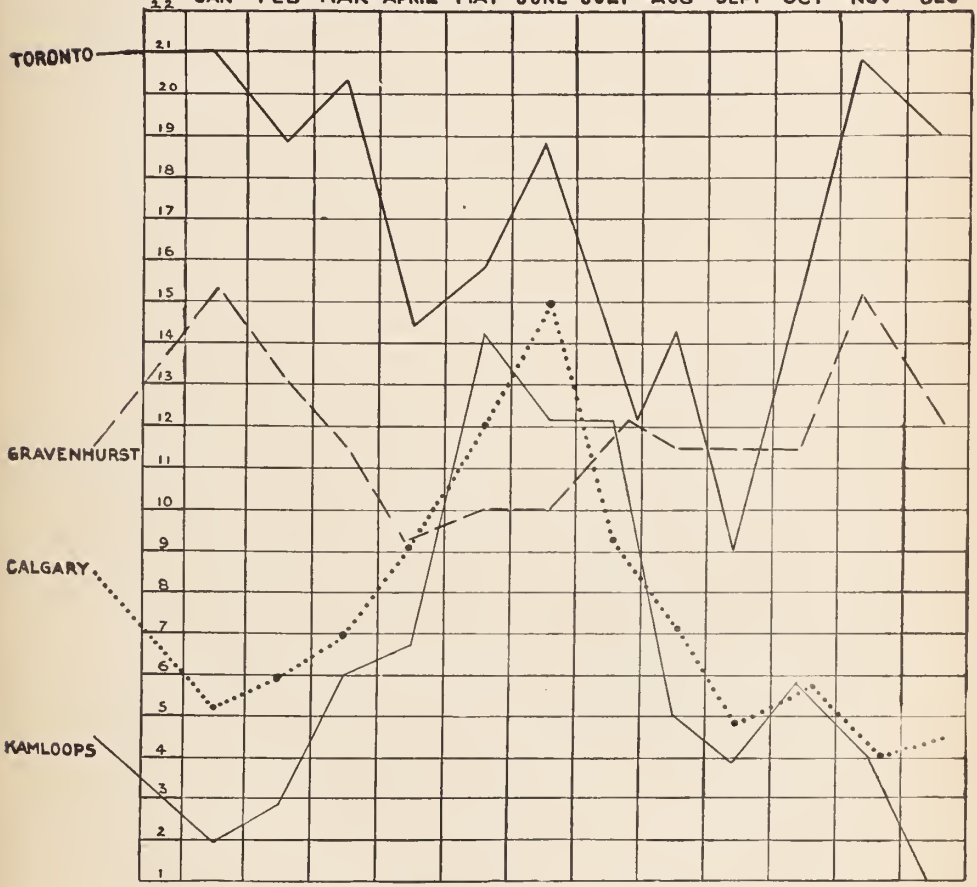
Fig. III. Annual Rainfall in Inches.



January are as follows:—25·6, 22·7, 28·7, 33·3, 43, 50·7, 60·3, 60·1, 55·8, 49·6, 38, 28·9°.

The isotherm passes through Montreal, Marquette, Michigan, Northern Minnesota, and North and South Dakota. The

Fig. IV. Annual number of Rainy Days by Months



annual rainfall is over 50 inches; the mean relative humidity over 80 per cent.; and the annual cloudiness over 60 per cent. The summer is the only desirable season for visiting Newfound-

land, and even then provision must be made for cold weather. Men suffering from nervous depression or mental fatigue, who might be interested in sport or in the remarkable scenery of the region or who would escape hay-fever, constitute the class of cases likely to receive benefit from such a trip.

PRINCE EDWARD ISLAND.—Prince Edward Island, called the "Garden of the Gulf," is north of Nova Scotia in the Gulf of St. Lawrence, and is reached by the Intercolonial Railway, or by steamer to St. John. There are good accommodations at Charlottetown and good fishing and shooting in the vicinity. The climate is cool and fogs are likely to occur, but the air is stimulating and the scenery fine. Summerside, near the western end and Rustico Beach on the north side are favourite resorts.

CAPE BRETON.—The island of Cape Breton is an island north-east of Nova Scotia. The climate is cool and the humidity is high. It is unsuitable for the tuberculous, but is attractive for overworked business men, neurasthenics, and those who enjoy a marine climate. Inland salt-water lakes render the country extremely picturesque. Bras d'Or Lakes penetrate the island, and Baddeck is delightfully situated near the centre of the island. The Margarie is a famous salmon stream.

NOVA SCOTIA.—Nova Scotia is a peninsula with a cool ocean climate. It is a favourite resort of the tourist in summer. The climate is too damp for invalids, but a summer voyage to Nova Scotia is refreshing to the overworked, and the scenery is the main attraction. Sufferers from hay-fever find immunity at the usual resorts of Nova Scotia. Warm clothing is imperatively demanded.

HALIFAX (latitude 45° north), a fine seaport on the ocean side of Nova Scotia, is interesting for its citadel and fine view of the harbour. It is a good resort for those suffering from hay-fever, and makes a convenient destination for those desiring a short northerly ocean voyage from the United States. The climate is cold and damp, and fogs are common.

NEW BRUNSWICK.—North of New Brunswick is the famous Chaleur Bay, north of which lie Bonaventure and Gaspé, counties of Quebec. The rivers emptying into this bay are famous for remarkably fine salmon fishing, and are visited in June by men of distinction from various parts of the United States and Canada. The principal rivers are the Restigouche, Nepisiguit, Jacquet, Metapedia, Cascapedia, Bonaveuture, and St John's of Gaspé. There are numerous club-houses, such as the Camp Harmony Angling Club on the Restigouche, the famous millionaire fishermen's club-house known as the Restigouche Salmon Club, fishing lodges, and a few primitive hotels where visitors are entertained. While all the best fishing grounds are in private hands, fair salmon fishing and trout fishing can be had by those who are not members of clubs.

Bathurst, on the south shore of Chaleur Bay, and New Carlisle, on the north shore, are summer resorts, and there are fine beaches where bathing is enjoyed in midsummer. The Chaleur Bay is not reached by the Arctic current, and its shallow waters are warmer than those farther to the eastward.

Among other attractive places are Dalhousie and Campbellton, N.B., Carleton, Gaspé and Percé, P.Q.

In southern New Brunswick, St. Andrews is probably the best known resort. It has an excellent hotel with famous links, and has a climate very much like that of Eastport, Maine, which is across the bay. Its mean yearly temperature is about 40·5° F., with a maximum of 81·6° and a minimum of 17°. The rainfall is 53 inches, and mean annual relative humidity, 73 per cent. The summer climate is cool and rather sedative. St. Andrews is a very quiet, colonial town, and is easily reached from Eastport by boat or by the Atlantic division of the Canadian Pacific Railway. St. John, on the Bay of Fundy, is a city of 50,000 inhabitants, and has a cool, stimulating climate. It is used to some extent as a resort. The Chaleur Bay resorts are reached by the Intercolonial Railway from Quebec, Halifax, or St. John; or from Frederickton *viâ* Canada Eastern Railway.

Along the St. Lawrence there are a few summer resorts below Quebec, that are attractive. Chief of these are Murray Bay on the north shore, and Cacouna on the south shore below Riviere du Loup. The bathing, boating and character of the accommodations are excellent.

Tadousac, on the St. Lawrence, near the mouth of the Saguenay River, is a well situated and a favourite resort.

Fig. 5.—Tadousac; Mouth of the Saguenay, Lower St. Lawrence.

Beyond Tadousac, the north shore is desolate and forbidding and is little visited. Roberval, near Lake St. John, is the northernmost resort in Quebec, and is very attractive for sport afforded and for its excellent accommodations.

Newfoundland, Cape Breton, Nova Scotia, and Prince Edward Island are exposed to the influences of the Atlantic Ocean and of the cold Polar current which sweeps down from

the coast of Labrador, bringing ice and fog and chilling the air for a large portion of the year.

These regions are beautifully green in summer and capable of agriculture, although the season suitable for such operations is short. Their exposed position and variability of weather render the climate a trying one and tolerable as a permanent place of residence only for those in vigorous health.

Fig. 6.—Capes Eternity and Trinity, Saguenay River, Quebec.

In the eastern provinces it is not uncommon to have early in the year a period of intense cold followed by a revulsion of temperature commonly known as the "January thaw." The temperature of the coast is not one of great extremes, and in summer is of remarkable equability.

Trips to New Brunswick, Nova Scotia, Cape Breton, and Newfoundland are sometimes advisable for the sake of recreation, but only in midsummer fine weather may be found, but

even at that season cold weather will certainly be met with, and the warmest clothing and waterproof garments will be needed.† The proximity of fields of ice and fog banks renders these trips sometimes disappointing. Off the shore of Nova Scotia, and particularly Cape Breton, rapid changes of temperature occur with the advent of fog. The islands of the Gulf and particularly those of the Labrador coast abound in waterfowl, but they are also infested with voracious black flies and mosquitoes. Excursions are often interrupted by fog, and many accidents have occurred to those who, having wandered too far from their base of supplies, become enveloped in these unwelcome clouds that roll in from the sea.

The straits of Belle Isle are frequently crowded with floating ice at this season, and bergs are familiar objects all along the Labrador.

In August the days are warm and it is possible in a voyage to these shores to observe a temperature as high as 78° F. while a hundred or more icebergs may be counted from the ship's deck. The usual temperature during cloud or fog at this season is about 45° F., and ordinary winter clothing is found to be no adequate protection from its penetrating chill. Heavy underclothing and outer garments, blankets, rubber coats, leggings, and heavy leather boots are indispensable.

For anybody who is thoroughly strong and healthy, free from any tendency to lung trouble, with a fondness for gunning, fishing, and "roughing it," such a trip will afford much amusement, provided a congenial party participate and the vessel be especially fitted with conveniences suitable for their entertainment.

In the province of Quebec, about one mile from Ste. Agathe des Monts, the Laurentian sanatorium for the treatment of tuberculosis was recently inaugurated, but was destroyed by fire in

† For an interesting description of Cape Breton Island and Nova Scotia, See "Baddeck," by Chas. Dudley Warner.

June, 1902. Ste. Agathe is sixty-four miles from Montreal, and is largely built up with summer residences. The institution was about midway on the declivity of a hill, at an elevation of 1,550 feet. The soil is very porous; the drainage is thorough. The Laurentians have been called the "Adirondacks of Canada," having many of the features, physical and climatic, of that celebrated plateau, their average elevation being about 1,500 and 1,800 feet respectively. The immense pine forests, together with the moderate temperature, constitute the chief characteristics of this Canadian district. We trust that the Laurentian Sanatorium will be soon rebuilt. It was well conducted and seemed destined to a wide sphere of usefulness.

ONTARIO.—The Caledonia Springs are about half-way between Montreal and Ottawa. They are saline sulphur waters and are useful in the treatment of gout, rheumatism, and allied neuralgias. There is a complete bathing establishment, and the waters are sold extensively. The St. Leon and Alpha Springs, near Arnprior, are of similar character.

The THOUSAND ISLANDS lie in the St. Lawrence River, between New York and Canada, near the outlet of Lake Ontario, and extend down the river for forty miles. This remarkable group of islands numbers over 1,600, some are several miles in length. They afford delightful sites for cottages and camps, and are well provided with hotels. The principal islands are Round Island and Wellesley Island, directly opposite Alexandria Bay. Alexandria Bay, the lakes of Theresa, Clayton, and Cape Vincent, near Lake Ontario, are excellent for fishing and abound in camps and cottages. The air is cool and stimulating, and the entire region is useful for the relief of hay-fever and insomnia. The annual mean temperature at Ogdensburg, fifty miles down the St. Lawrence, is 45·2° F., and during June, July, August and September, the means in 1899 were 65·8, 68, 70·7, and 58·2° F. The extremes were 20 and 93° F. The Thousand Islands are reached by the Grand Trunk Railway from Montreal or Toronto, or by steamer.

Fig. 7.—Wild Deer in Highlands of Ontario.

Two miles from the town of Gravenhurst, on the northern division of the Grand Trunk Railway, 115 miles from Toronto, is situated the Muskoka Cottage Sanatorium for the treatment of tuberculosis. It has an altitude of nearly 800 feet, and is on the shores of Lake Muskoka. The building is in a beautifully wooded park of fifty acres, and is sheltered from north and north-west winds by rocky ridges and pine forests. The soil is

FIG. 8.—A TYPICAL SCENE ON THE MUSKOKA LAKES.

porous, dry, and of rocky formation, of the Laurentian system. The water is soft. The climate is bracing, and the region is considered favourable for the relief of asthma and hay fever. The present sanatorium accommodation is for patients in the incipient stage. The main building was erected in 1897 by gifts from Messrs. W. J. Gage and Hart A. Massey, of Toronto, at a cost of 50,000 dols. The results of treatment have been encouraging, the last report showing 21 per cent. of apparent

cures, besides 32 per cent. of cases in which the disease was arrested. A longer stay than three months is necessary, even in the earlier stages. Most of those discharged with the disease arrested have returned to their work, while others have taken up out-of-door work, such as farming.

The Free Hospital for Consumptives occupies a site of fifty-six acres on the lake about one mile from the Cottage

Fig. 9.—Lake Rosseau.

Sanatorium; it was opened in 1902 with a capacity for fifty patients. It is under the same management as the Cottage Sanatorium, and was erected by Mr. Gage and the Massey Estate.

There are no places in the immediate vicinity outside of these sanatoria where persons may find satisfactory accommodation if recommended to seek this climate for the relief of pulmonary disease. There are, however, various small hotels throughout the lakes and a modern well-appointed hotel, the Royal Muskoka, three hours distant by boat from Gravenhurst, where tourists are received during the summer.

The Georgian Bay extends eastward from Lake Huron; the Muskoka Lakes are near its southern end. In the bay are over 30,000 islands which resemble closely the Thousand Islands of the St. Lawrence. The innumerable channels are traversed by steamers which afford a most fascinating trip from

Fig. 10.—A Portage on the Moon River.

Penetang to Parry Sound. Penetang is one hundred miles from Toronto by rail and is a favourite summer resort. The islands are well wooded and afford excellent camp sites. This region is well adapted for sufferers from hay-fever. There are various resorts, such as Honey Harbour, Midland, Rose Point, Moon River, Sans Souci, where summer visitors find satisfactory accommodations at very moderate cost. There is good fishing

at nearly all of these points and convenient access to the Magnetawan River, Muskoka Lakes, Lake Rosseau, and Lake Joseph. All these points are easily reached by the Grand Trunk Railway from Toronto.

Toronto (latitude 43°, 40′ north) is on the north shore of

Fig. 11.—Fishing on the Moon River.

Lake Ontario. It is one of the most beautiful cities in Canada, and has a salubrious climate. The drainage is thorough and there is a fine water supply. One of the interesting features of Toronto is the City Dairy, which receives and prepares for distribution by most approved methods, nearly all the milk sold to the inhabitants. The rigid system of inspection and bacteriological examination ensures a satisfactory service.

There is no malaria in Toronto and very little in Ontario. The disease occurs to a slight extent on the northern shores of Lake Erie and in the flat regions near Lake St. Clair. Lakes Ontario, Huron, and Superior are free from it. It has largely disappeared in the Province of Quebec and is unknown in the Lower Provinces and rare in the north-west. The great Lakes

FIG. 12.—PENINSULAR LAKE, LAKE OF BAYS.

are visited in summer to a large extent. The various resorts are too numerous to mention here. The writer prefers Lake Superior to all the others because of its cooler air, its wilder and more picturesque scenery, its greater opportunities for sport, and because he has had a more intimate personal experience of its many attractions, on both the Canadian and American side, than in case of the other lakes. The elevation of the lake is 606 feet.

On the Canadian side the principal settlement is about Thunder Bay at the head of which Port Arthur and Fort William afford accommodations. These places are now easily reached by steamer or by the Canadian Pacific Railway, and are suitable places in which to prepare for further excursions to attractive camping and fishing grounds. Nepigon River, the

FIG. 13.—MCLEAN CHANNEL, AMONG THE 30,000 ISLANDS OF GEORGIAN BAY.

outlet of Lake Nepigon, is 64 miles east of Port Arthur, and is famous for its wonderful trout fishing, the finest trout stream in America. The basaltic cliffs of Pie Island, Isle Royale, and Thunder Cape add a grandeur to the region of Thunder Bay, and make a profound impression on the tourist who takes the time to explore, by boat or canoe, the north shore of this superb lake.

To what extent and in what way can this climate be utilised? For what classes of cases is it desirable to recommend this region?

Men, and especially young men, would naturally enjoy it most. There are some localities where women will find suitable accommodations, such as Port Arthur, or Fort William, or Sault Ste. Marie, and if ladies have had previous experience in camps and if a number of them can go together, a camping trip on Thunder Bay or the Nepigon River is within the range of propriety and possibility.

No one who requires any special article of diet, or who is liable to sudden or severe illnesses, should venture far from a base of supplies and the more civilised stations. No one with active pulmonary or cardiac disease should go on camping expeditions in these regions. While the air is exhilarating, there are sometimes violent atmospheric changes and deluges of rain that render camp life not altogether devoid of trials. No one who is unable to tramp over carries for a mile or two, with at least a gun, or who is unable to take a turn at the paddle or an oar, should enter upon such long trips. While a certain amount of physical endurance is necessary it is also of the utmost importance that whoever is responsible for the safety of the members of the party should have a strong will and good judgment. It is not safe to trust to the advice of Indian guides. These men need a firm control and explicit directions, and will accomplish more and be far more satisfactory when held under strict discipline. But in respect to transportation, especially with reference to bad weather, their cautions should be respected.

Probably the best results of such expeditions are obtained in cases of melancholia and hypochondria. If it is possible to secure the services of a young physician or intelligent medical student of force of character and tact, familiarity with travel and particularly out-of-door life, then much can be done in these cases. The writer has in mind the case of a young lawyer whose despondent condition was the result of a partial sunstroke received in training for a boat-race. Melancholy was so intense as to lead the relatives to fear a termination by suicide. European travel afforded no relief. The plan of sending him

to the north-west in charge of a bright medical student was finally successful in restoring him to health.. The exhilarating, cool atmosphere and an entirely new mode of life changed the habits of thought, sharpened the appetite, and brought refreshing sleep.

The season on Lake Superior opens late and it is not desirable to visit the north shore before the first of July. The woods are dense and campers and voyagers are subjected to many annoyances at earlier dates which are somewhat mitigated after the latter part of the month. The greatest obstacle to exploring and fishing trips early in the season is the black fly. This insect is found all through the north woods and is a persistent and thirsty foe to any who intrudes upon his domain. Mosquitoes are also formidable enemies, and throughout Canada, and especially Manitoba and Alberta, will be found most exasperating as soon as one enters the woods and thickets. In August the flies lose much of their vitality and are well warded off by applying to exposed parts of the body various preparations of oil of tar and oil of citronelle, without which it would be folly to undertake any expedition into this wilderness. Mosquitoes retain their pernicious activity all through the season, and netting is required at night and sometimes by day for protection from these pests. Nowhere in the United States do mosquitoes make such havoc with the human features as in Manitoba, while black flies, if permitted, will draw streams of blood which run down over the face, and by their wounds even close the eyes and render the unfortunate victim unrecognisable. No one who has not experienced their onslaughts can appreciate how much misery these insects cause the unwary, and it is deemed wise to inform those who contemplate these interior trips what they must prepare for and go armed accordingly. With proper precautions all the delightful features of camp life may be enjoyed at the proper time, and if the trip be chosen with intelligence no hardship need be experienced.

MANITOBA.—Winnipeg, 1,424 miles west of Montreal, at an

Fig. 14. Map of Part of Lake Huron.

elevation of 700 feet, has a population of 45,000. It is a substantial city, the capital of the province of Manitoba, and the chief post of the Hudson's Bay Company. It is the great trading centre of the plains. Its climate is remarkable for the great annual range of temperature, amounting in 1899 to 135·9° F. The mean temperature is lower than that of any other large city in America—viz., 34·2° F. The lowest sun temperature was—16·5° F., and the lowest recorded in the shade was—46·5° F. The maximum is 90° F. There is no malaria, but in the woods mosquitoes and black flies are formidable pests. The climate is stimulant and is especially dry during the colder six months of the year. There is nothing to peculiarly interest the visitor, and there is no inducement to break the transcontinental journey at this point.

One hundred and thirty-three miles east of Winnipeg is Rat Portage on the Lake of the Woods. The lake is studded with islands and is a favourite resort for sportsmen. The lake is very picturesque, and the town has a population of 5,000.

Throughout Manitoba and from the Red River to the Athabasca, the range of temperature throughout the year is very great. The intense cold of winter is followed by a summer in which the nights are cool but the midday is often quite hot.

"Early in April the alders and willows of the Saskatchewan country are in bloom; the prairie anemone covers the southern exposures to the very verge of the retreating snow. May, there, brings with it more of the true summer heat than in the provinces of the St. Lawrence; but the evenings are cool, and throughout the periods of greatest heat the night breezes beget a welcome and refreshing change, accompanied with heavy dews. This protects the cereals from the effects of drought even in the driest seasons, and produces a rich growth of prairie grass." The Rev. Prof. Bryce, of Winnipeg College, Manitoba, writes: "The juncture of the seasons is not very noticeable. Spring glides insensibly into summer, summer into fine autumn weather, which, during the equinox, breaks up into a series of heavy

gales of wind accompanied by rain and snow. These are followed by that divine aftermath, the Indian summer, which attains its true glory in the north-west. The haziness and dreamy fervour of this mysterious season have often been attributed to the prairie fires, which rage over half a continent in the fall and evoke an enormous amount of heat and smoke."

Fig. 15.—Banff Hotel, Alberta, Canadian Rockies.

In Southern Alberta, Chinook winds blow frequently during the autumn, winter, and spring, licking up the snowfall and raising the temperature, so that there is a good deal of warm, bright, spring-like weather in which the ground is bare of snow.

In Saskatchewan and Alberta the winter begins in November and continues until March. Wheat is sown in April and the harvest begins in August. Oats, barley, and rye, and hay are grown successfully everywhere. In the fertile valley north of

Fig. 16.—Lake Louise, near Laggan.

Edmonton, Alberta, there are large herds of cattle. Immigration follows the railway lines with amazing rapidity. During 1898-1899 and 1900, 17,000 immigrants came into Northern Alberta. From present indications about 10,000 persons will take up residence in this territory during the coming year.

FIG. 17.—VICTORIA GLACIER, LAKES IN THE CLOUDS, NEAR LAGGAN.

ALBERTA AND BRITISH COLUMBIA.—Calgary, in the province of Alberta, is 840 miles west of Winnipeg, and has an elevation of 3,500 feet; population, 5,000. The climate is dry and bracing. The mean anuual temperature is about 35° F. The mean annual rainfall is 11·5 inches. Tuberculous patients who are fairly robust find at Calgary a cool, stimulating climate

FIG. 18.—VALLEY OF THE TEN PEAKS, NEAR LAGGAN, B.C.

suitable for them during the warmer months. There is also a good general hospital.

Banff is on the eastern slope of the Rocky Mountains in the Rocky Mountain Park of Canada. This park embraces over 4,500 square miles and includes the Yoho Park Reserve. The beautiful Bow Valley, Ghost River, Lake Minnewanna, and

Fig. 19.—Takakkaw Falls, near Field, B.C.

scores of mountains ranging from 8,000 to 11,000 feet high, are included in the Reserve. Banff itself has an elevation of 4,500 feet, and the C.P.R. Hotel has a beautiful site at the confluence

FIG. 20.—TWIN FALLS, YOHO VALLEY, NEAR FIELD, B.C.

of the Bow and Spray Rivers. The valley is of rare beauty; the rushing waters and snow-topped mountains are characteristic of the entire region. The hotel is three miles from the station,

it is well equipped and is open during the summer months. The air is exhilarating and there are good drives and many interesting excursions can be made.

FIG. 21.—MT. SIR DONALD, SELKIRK RANGE, NEAR GLACIER STATION, C.P.R.

The locality is said to afford exemption from hay-fever. The hot sulphur springs, varying in temperature from 80 to 121° F. contain calcium and magnesium sulphate. They are on Govern-

ment property and the water is conducted in pipes to the hotel and to a sanatorium near by. The hotel has a large swimming pool with tub baths, and the water is kept at 98° F. At the Sanatorium there are various hot and steam baths with spout and needle baths; gout, rheumatism, and similar affections have been successfully treated. This institution has facilities for general hospital work, and is under competent direction, but the accommodations are not adequate to what should be expected at so important a resort.

Laggan, thirty-five miles west of Banff, is the station from which side trips are made to Lake Louise, Lake Agnes, the Victoria Glacier, the Valley of the Ten Peaks, and the Paradise Valley. This region abounds in superb scenery, and well repays the visitor who will remain long enough to explore the many wonderful valleys and the mountains, which must be seen to be appreciated. The best time to visit the Rocky Mountains of Canada is after July 1; before that date the weather is liable to be cold and wet and many of the most interesting places in the neighbourhood of Lake Louise, Mirror Lake, and Lake Agnes are not easily reached on account of snow and ice. The accommodations at Laggan and Lake Louise consist of small chalets, and from them Swiss guides may be engaged for the excursions in the vicinity.

Field, fifty miles west of Banff, is a favourite stopping place for tourists, and there is an excellent chalet hotel near the base of Mt. Stephen and facing Mt. Field. The altitude is 4,052 feet, and there is a magnificent view of the valley. The Takakkaw Falls may be easily reached from Field. They have a sheer drop of 1,200 feet and are among the most remarkable in the world. The Yoho Canyon and Twin Falls may be visited in a day, and also the beautiful Emerald Lake.

Glacier Station, eighty-four miles west of Field, has an altitude of 4,122 feet. The scenery is inspiring and there is much to interest visitors who can climb mountains and explore the glaciers. Swiss guides are stationed here.

Banff, Field, and Glacier are at about the same altitude, and are in practically the same climate. These places have not as yet been described as health resorts, but merely as attractive railroad stations in the mountains. They are suitable in summer for persons who need a stimulating climate at a moderately high elevation. Neurasthenics who can appreciate mountain scenery

FIG. 22.—THE SECRETARY OF THE AMERICAN CLIMATOLOGICAL SOCIETY ON THE GREAT GLACIER OF THE SELKIRKS.

and can afford the trip will be greatly benefited in the Canadian Rockies. The advantages that these stations possess are that the number of invalids who visit them is small, and the ownership of the hotels or chalets by the Canadian Pacific Railway insures the best of accommodations.

THE ARROW LAKES.—These lakes extend from Arrowhead, twenty-eight miles below Revelstoke, to Robson, a distance of

FIG. 23.—ILLECILLEWAET VALLEY, NEAR GLACIER STATION, C.P.R.

about 125 miles. They are expanses of the Columbia River and have an elevation of 1,390 feet above sea-level. The upper and lower Arrow Lakes are connected by a narrow passage through which the waters pass southward in a strong current. The shores are bold and mountains, many of them snow-capped,

Fig. 24.—Kicking Horse Canyon, C.P.R.

rise abruptly from the lake. Many of these peaks are 6,000 to 8,600 feet above sea level. The waters of the lake are too cold for bathing owing to the melting snow, but on the eastern shore of the Upper Arrow Lake there are two hot mineral springs. The Halcyon Springs have a temperature of 126°, are calcic, saline, sulphated, sulphuretted, and are piped 300 yards to the hotel near the lake shore. There are two plunge baths

and individual baths, and the water is shipped for use. The springs are reputed to be valuable in the treatment of rheumatism, which is a common complaint among miners who are constantly exposed to wet and cold. Access is by boat ten miles from Arrowhead.

Fig. 25.—Steamer on Arrow Lake, B.C.

There are also the St. Leon Springs, fourteen miles from Arrowhead. The waters are hot at their source, and piped about a mile to the hotel, which is near the lake side. The waters are heated for use and employed in the treatment of rheumatism.

Both these hotels are open during the entire year, but there is at present no medical attendant nearer than Revelstoke, thirty-eight miles distant. There is a daily boat each way.

The Arrow Lakes are rarely frozen in winter. Navigation

is open throughout the year. They are little known by tourists, and only within the last ten years have they been accessible by rail. There is very little evidence of civilisation; mountain goats and bear are occasionally seen. There are grouse, but duck are scarce. The lakes abound in salmon and lake trout. Brook and rainbow trout are also found.

The lakes are comparatively free from storms, although showers are frequent in summer, and high winds, and are well suited for canoeing, boating, and for small launches and house-boats. These are to be had on Shuswap and Kootenay Lakes.

The Kootenay Lake has an elevation of 1,500 feet, and has the same general features of the Arrow Lakes. It empties near the town of Nelson into the Columbia River. Lake Windermere, Kootenay Lake, is a good location for camps. The geologic formation is of grey and reddish granite with gneisses, mica schists and argillites. There are rich deposits of gold and silver all through this region, especially in the vicinity of Nelson, Slocan Lake, Rossland, and Okanagan Lake.

KAMLOOPS.—This town of about 2,000 inhabitants is in the valley of the Thompson River, 250 miles east of Vancouver. Its altitude is 1,160 feet and the air is dry and invigorating. The annual rainfall is ten inches. It is better situated than any other place in British Columbia for the treatment of pulmonary affections, since it affords proper climatic conditions and, through C.P.R. railway service, proper access and supplies. There is no special provision for the care of tuberculous patients, but it is quite likely that an institution will be established there at no distant day. Kamloops is much drier than towns on the Pacific or stations in the Rocky Mountains, and there is more wind.

The writer desires to call especial attention to this mountain region of British Columbia. He has recently visited it and trusts that the imperfect notes presented herewith will prove an encouragement to others to make further studies in this most interesting region just beyond our northern boundary.

DISCUSSION.

Dr. TAYLOR: I would like to add a few words to what has been said about the Muskoka Sanatorium. This institution is conducted by the National Sanatorium Association formed in Toronto, and I think it is an organisation that might well be imitated by others who desire to follow this sort of work. Their plant, if the term be allowable, is an ideal one, comprising a cottage sanatorium for the well-to-do, and institution for incipient cases among the poor, and a hospital for far advanced cases. The one described in the paper is on the model of Trudeau's Adirondack Cottage Sanatorium at Saranac Lake, and is reserved now for patients able to pay from ten dollars to twenty-five dollars a week. In the newer one, patients are put in wards with from four to ten beds each at a nominal cost; and this same organisation has a hospital near Toronto where people may go to die, which is a necessity if they wish to keep advanced cases away from the Sanatorium.

In regard to the shores of Lake Superior we make a great deal of use of them in sending our hay fever patients there for treatment, and with very good results. The doctor made one statement which I shall have to contradict. He said that the trout fishing in the Nepigon is better than anywhere else in the world. I don't fish myself, but I have to listen to a great many fish stories, and I think, if these be any guide, you can get bigger trout in the Brulé River than in any of the streams flowing into Lake Superior from the north.

Dr. CURTIN: I was very much pleased with Dr. Hinsdale's paper, as it concerns a region a knowledge of which is valuable to us as climatologists. Some twenty-five years ago I spent three summer vacations in Nova Scotia, and at that time I was surprised to find tuberculosis in that province so prevalent. The physicians explained its presence by constant dampness caused by frequent fogs.

SANATORIUM TREATMENT OF TUBERCULOSIS IN COLORADO.

DR. S. E SOLLY.

COLORADO SPRINGS.

I NEED not waste the time of this Association in discussing the value and importance of sanatorium treatment; you are all agreed upon that, but there is one thing that perhaps you are not agreed upon and that is to write and call it *sanatorium.*

In Colorado we have been suffering with a lack of sanatoria for many years. I have individually made many attempts to get them established, and recently the opportunity has come to me to start up this project again. A gift of 50,000 dols. and one hundred acres of land has induced me to work again at the subject; but, before attacking the purses of my friends, I thought it well to draw up plans and to consider the ways of carrying them out. The idea that I have about it is one that has been successful in Germany, of building an institution for the well-to-do, one that will bring in a profit, and then to use the profit to run another institution for the poor. I believe it is better in sanatoria that the doctor should not be interested financially, but that he should be adequately remunerated where the patients are able to pay. It has been estimated by those who have done this work in Germany that an institution for a hundred pay patients can run another of fifty poor people free of charge. It is questionable, perhaps, whether it is well to have an institution absolutely free, or whether a small charge should not be made, say 5 dols. a week, and supplement that from the profits of the pay department. For patients unable

to pay this small sum, it might be provided from some charitable fund or endowment.

My plan is to use the out-door treatment as fully as possible, and in Colorado Springs we have found that our patients can sleep out-doors the year around, and those having the facilities to do so have had porches added to their houses where they were lacking. That is the idea which forms the basis of the building that I am going to describe to you now.

The cottage plan of building has been very successful in some places, and the pavilion plan has worked well at others, and finally there is the more compact plan of one large building such as you see in these drawings—one large central building with two wings at a right angle therewith so that every room shall get sunlight during most of the day. In both the cottage and the pavilion plans we have the objection that patients have to travel some distance, no matter what the weather, from one building to another, and it is also more expensive to provide heat and light. Therefore I have determined that the best plan is to put up a five-story building such as you see illustrated here. The noises from one room to another or from one floor to another can be greatly diminished by closing off the stair-cases and casing the elevator, &c. All the rooms are on the south side of the building, and will be about 12 by 14 feet, with an open front porch, 8 by 12 feet, where the patient can sleep and, if desirable, pass the entire day. Ventilation is obtained from below, the air passing out above is driven by fans. The porches are separated one from another by walls. One bath room is provided for two patients' rooms, but a private bath can be obtained if the second patient uses the bath room across the large hall. The first-floor plan shows the reception rooms, the doctor's offices, dining room, open on all sides, except the north, a large amusement hall and laboratories. The kitchen and laundry are in detached buildings.

It is proposed to erect this building under the bluff about

300 feet above the town, so as to shelter it from the north and west winds.

DISCUSSION.

Dr. BOWDITCH: It will be perhaps unnecessary for me to say much to-day after my remarks yesterday upon Dr. Lindley's paper, and yet I cannot refrain from expressing my gratification at Dr. Solly's idea of establishing a sanatorium at Colorado Springs such as he describes. It would be of infinite benefit to a large class of wealthy patients who need such places as much as the poor, and, as Dr. Solly says, if the income which comes from it could be devoted to the maintenance of a similar institution for poorer people, as is done at Falkenstein, it will be an inestimable boon to many a sufferer and to the community at large. May success attend his efforts. May I here, at the risk of seeming to be a *purist*, ask everyone here to protest against the apparently growing use in the lay papers and elsewhere of the mongrel word "Sanitorium," a mixture of spelling enough to make any lover of good English and Latin shudder. It is unfortunate that we have the two words "Sanitarium" and "Sanatorium," but at least let us not make matters worse by manufacturing a monster that is "neither fish, flesh, nor fowl."

Dr. SEWALL: It seems to me that, in considering plans of this sort, the first thing one should do is to consider what he wants to accomplish. As I look at it, there are two points of view in the consideration of the tuberculous patient. A patient with a normal temperature and normal heart, no matter how severe his lesion, can, relatively speaking, take care of himself, and only wants fresh air day and night; but the patient for whom the doctor is especially responsible is that one who has a daily rise of temperature. Such a patient, in my opinion, needs, for certain periods at least, complete rest in bed, *out of doors*. It should be possible to roll the bed easily from the room to the verandah, and the latter should be partly covered and partly open above. I think there should be no return to the bedroom except for emergencies or for toilet purposes. Not in the whole of Colorado, so far as I know, is there any institution where these simple ends may be attained.

Dr. FISK: I want to call attention to the work this Association is doing. Our membership combines, from the gulf to the lakes and from ocean to ocean, most of the men who are doing the work in sanatoria. I might mention among these Fremont-Smith, Taylor, McGahan, Coleman, Hinsdale, Trudeau, Bowditch, Knight, Babcock, and the noble representatives both of Colorado and California. The work that Dr. Solly has pointed out will be done more largely in the future, and my attention has just been called to the fact that we are to have a Tent Sanatorium in Denver which has been amply endowed. The sanatorium which Dr. Solly has been

dreaming of is going through. He spoke of a bluff, but I assure you there is no *bluff* in it.

Dr. SOLLY: Dr. Sewall's idea that it is necessary for the patient to have only a dressing room is a good one. In the midst of our enthusiasm for open-air treatment we have to consider those that are thin-blooded and catarrhal. The air bath, however, is a good one for some patients. I know of one institution where they have a shower bath in each room, and there is no doubt that the close proximity of the bath room to the sleeping room is an important feature.

ALTITUDE IN FACT AND FANCY.

BY HENRY SEWALL, PH.D., M.D.
DENVER, COLORADO.

THE field of the medical climatologist, like that of the sanitarian, is one which continually broadens and deepens before the view as the investigator reaches successively higher and higher points of observation. It would seem to be not impertinent, even before such an Association as this, for each contributor now and then to map out his bearings as an aid to future progress.

We must depend upon the meteorologist for *data* concerning the physical factors which determine the differences of climates. We must look to the physiologist for instruction as to the vital reactions of the normal body to varied meteorologic conditions. But it is on the observations of the clinician, which are fortunately unlimited as to number, but devoid, for the most part, of the searching test of experiment, that we must found our conclusions concerning the influence of climate on living man, sick or well.

Thus the clinician is forced to undertake the solution of some of the most complex problems in physiology and pathology, while, at the same time, he is almost completely deprived of the most valuable aid to scientific investigation, that of experimental verification. It is not surprising, therefore, that in the field of medical climatology the worker is particularly liable to be the victim of the errors to which all original investigators are subject, chief among which are, perhaps, first, inexactness

of observation; second, the interpretation of facts by fancies which lead to some preconceived hypothesis, or which satisfy some personal desire. The physical *data* of meteorology become thus the ornaments of his generalisations rather than their foundation. Possibly there occurs to each one here present illustrations of such errors of observation or of logic in climatological writings.

A resident of the city of Denver, at an elevation of one mile above sea level, the writer has naturally come to estimate the biological influence of altitude as a factor in certain medical cases. In the popular mind of dwellers among or near mountains every function of life is modified or determined by the influence of "thin air." Yet when we attempt an analysis of the physiological relations of altitude, we find at once that we are dealing with a combination of different and hardly separable physical factors; for with the low barometric pressure of elevated regions go low humidity, more sunlight, less atmospheric absorption of solar rays and corresponding increase in their kinetic energy, a magnified difference between the temperatures in the sun and shade and of day and night, new conditions for the evaporation of water and for the absorption and radiation of heat, not to speak of the little known relations of the storage and dissipation of electric energy. All these physical factors, and possibly others that we know not of, are changed when we proceed from one telluric level to another, and the physiological effect is the resultant of their combined action. We are interested in these meteorologic phenomena only in so far as they are reflected in the reactions of the living organisms and so give rise to the science of climatology.

How insufficient mere physical *data* are for the deduction of the climatologist has been pointed out by Captain Glassford and others by showing the lack of parallelism between the isotherms of ordinary *instrumental* and *sensible* or *physiological* temperatures.

Owing chiefly to the progressive aridity of the air with the

elevation, the dweller in a high altitude may actually experience the same summer temperature as one who lives at sea level much nearer the pole, and the same winter temperature as one closer to the equator; that is, the *sensible* temperature of a locality, or the temperature it would seem to us to have, is measured not so accurately by the dry bulb thermometer as by the wet bulb. In other words, the physiological effect of external heat is a function of at least two physical variables, heat and humidity.

As to the further physiological influence of the modification of glandular and nervous activity resulting from altered surface evaporation, we can now only conjecture. Then again, merely physical or meteorologic *data* involve nothing subjective. The modification of the psychical state, one of the most certain therapeutic concomitants of climatic change, is a matter that at present escapes all analysis. It may some day be shown that the psychological relations of climate are mathematically determined by the vast number of physiological variables that make up our machine life. How momentous such considerations must be in the treatment of many diseases it is needless to urge. No thorough exposition of the climatology of high altitudes can be expected until the physiological constants of life in such regions have been accurately ascertained. It is worth suggesting that the influence of this Association may properly be used in seeking to direct towards this subject part of the munificent endowments that have recently been made for the prosecution of original research. Only the best trained worker is competent to resolve into their simplest parts the problems that confront us, and there is no physiological problem so simple but requires for its solution the application of the finest technique and severest scientific reasoning. For example, everyone admits the constant apparent increase in the red blood corpuscles attendant upon removal to high altitudes, but this phenomenon attains an entirely different significance from that at first attached to it when it is considered that even a mo-

mentary impediment in a blood stream must cause a local congestion and corresponding increase in the number of blood corpuscles at that point. If it but be granted that an effect of high altitudes is to cause either vascular dilatation of the skin or more sluggish venous outflow therefrom, the curious results of the hæmatologist are explained without presuming an inordinate rapidity in cell multiplication. Indeed, it is, perhaps, more logical to suppose that the increase of blood cells in the peripheral circulation argues for a congested skin; and, if such be the fact, it is not a far-fetched presumption that some of the peculiar physiological attributes of high altitudes may be due to such excessive surface distribution of the nutrient fluid of the body. Such ideas are useful and even necessary as working hypotheses, but it is the chief purpose of this paper to insist that they be not used as argument until distinctly supported by experimental evidence.

The distinguished Italian physiologist, Angelo Mosso, made an exhaustive set of observations upon human respiration, gas exchange and circulation in the Alps at an altitude about corresponding to the top of Pike's Peak. Mosso's conclusions as to the depth of respiratory movement and the volume of gas exchange incident to high altitudes are directly at variance with the conceptions generally held by clinical writers. According to Mosso, moreover, the tension of carbon dioxide in the blood plays a hitherto unsuspected *rôle*, and he holds that abnormal diminution of that tension is the direct cause of so-called "mountain sickness." The careful reader will insist upon confirmation of these observations before accepting them; and it may be suggested that more purely physiological results should be expected from experiments carried on at a lower elevation and through longer periods of time. Nothing is more obvious than the change, temporary, at least, in the activity of the kidneys incident to change in altitude; yet evidence is altogether lacking as to the cause of this variation in secretion. It is important that we know what, if any, is the relation of

altitude to the elimination of metabolites, both nitrogenous and non-nitrogenous. Dr. Webb, of Colorado Springs, tells me that, according to his observations, the quantity of urea excreted by a person living in that place is very much less than the normal as estimated at sea level.

No physiological function rightly attracts more attention in its modification by altitude than does the circulation. The familiar attendance of cardiac dyspnœa upon slight exertion in high altitudes at once marks the heart as an organ whose function is directly affected by change in barometric pressure. The purpose of the heart in the body is solely to maintain a certain arterial blood-pressure; as yet we know nothing whatever of the effect of altitude upon this all-important driving force of the blood. Fortunately the heart submits itself with unusual completeness to clinical observation, and it seems to me that in our physical examinations we have culpably neglected estimates of the individuality and work power of the normal heart. At this point I am obliged to enter the dangerous ground of clinical observation unsupported by the prop of experiment. Provided their sources of error are held in view, the conclusions deduced can do no harm but may serve a useful purpose. It has seemed to me, in brief, that the characteristic effect of high altitude upon the circulation is an overloading, with a tendency to strain, of the right side of the heart. Some evidences for this view have been presented in detail in another communication.

Admitting tentatively the validity of the conclusion, two sequels must be considered; first, there would be entailed a higher venous congestion of organs, with probable modification of metabolism and tendency to the gouty or lithæmic state; second, the heart would either respond to the strain of heightened right-sided intra-cardiac pressure by increased vigour of contraction, leading to physiological hypertrophy and better nutrition throughout the body, or the organ would fail to answer the extra demands upon its powers; it would then dilate to the

right, more or less venous stasis would intervene, and the nutrition of the body would proportionately suffer.

It has seemed to me usually possible to determine by physical examination the character of heart that is not likely to bear well the strain of high altitude life. The clinical features which seem to me to indicate lack of reserve power on the part of the structurally normal heart are abnormal increase in the rate of beat with exertion, or on assuming the erect position; the easy production of dyspnœa with exertion; an increase towards the right of the area of cardiac dulness; undue prominence of the jugular veins in the recumbent position of the patient; but more significant than all, as it appears to me, is what may be called a wavering character of the first sound of the heart with a more or less marked reduplication of that sound. Finally may be mentioned that well-established sign of weakness, the shortening of the first sound with a change in its quality which makes it resemble the second sound, accompanied by more or less abbreviation of the lesser pause.

In my experience, persons suffering from pulmonary tuberculosis, however slight the affection, and manifesting these signs of heart weakness, do not usually thrive well at even a moderately high altitude; and I have repeatedly known such patients, while gradually failing, to immediately improve and proceed steadily towards recovery when sent, under proper conditions, to an elevation of less than 2,000 feet above the level of the sea.

The study of cardiac physiology in relation to pulmonary tuberculosis seems to me to be of supreme importance; partly because in this disease there is already thrown upon the right side of the heart a more or less excessive burden due to the restriction of the vascular area of the lungs. It was once my unfortunate experience to see a patient whose right ventricle was just able to send its blood through lungs far advanced in cirrhotic contraction go to ground after the administration of 15 grains of trional given to induce sleep.

The heart is at once the servant and master of every tissue, and the condition and power of that organ are fair indices of the state of the whole body. In the therapeutic relation I would consider the indications of altitude in pulmonary tuberculosis to chiefly depend upon the vitality of the heart. When this organ can adjust itself to the extra demands incident to considerable elevation above sea level, such reaction probably strengthens it throughout and leads to improvement in the nutrition of every tissue.

It has seemed to me that for every case of pulmonary tuberculosis there is an optimum altitude at which the patient has, other things being favourable, the best chance of improvement. This elevation may be any fraction of 10,000 above sea level. It is the altitude at which is secured the most thorough physiological reaction; let it be exceeded ever so little and the patient's vital powers are over-burdened instead of strengthened.

When the physiological relations of climate are better understood, the climatic treatment of *disease* will give way to the climatic treatment of the *patient*, and our advice will be more definitely founded on the effects on individual metabolism of the various meteorologic conditions available to us. No climate is a specific against any disease, but can only aid in its cure by facilitating in one direction or another the sum of the nutritional processes of the body.

Every climate has its typical effects on the living organism, just as every nation has its pictured type; but in judging a definite medical case the physician must use a type only as a point of departure. For example, the characteristic effect on the nervous system of a person recently arrived in Denver from the East is one of exhilaration; but some complain of depression and that the feet feel as heavy as lead. Some sleep worse, some better than in lower altitudes. One ill-founded fancy regarding the therapeutic relation of high altitudes to pulmonary tuberculosis seems general both among the laity and

the medical profession. It is that persons cured of tuberculosis in high altitudes cannot so safely return to lower levels as patients who have recovered health near their homes. It would require a volume of statistics accumulated through years of research to effectually combat this belief. But, in brief, I think I voice the prevailing opinion of those medical practitioners whose experience has included so-called "cures" in high as well as in low altitudes in maintaining that a re-infection or relapse is no more likely to occur in the one than in the other case when the patient has returned to the scene of his former life.

Without dwelling on the difficulties of achieving or estimating a "cure" in tuberculosis, it will be admitted that most of our favourable cases still show physical evidence of the disease, though the activity of the morbid process has been *arrested.* It is a matter of the highest importance to determine *why* it is that, of the arrested cases whose lives have been saved under appropriate climatic conditions, some return with impunity to the scenes of their former activity and take up again their chosen work, while others venturing the same change of base quickly lose ground and fatally relapse.

In conclusion, I venture to invite the attention of practitioners of high altitudes to an inquiry as to the physical signs by which we are accustomed to recognise the existence and extent of pulmonary tuberculosis.

To illustrate, a patient newly arrived in Denver presents a letter from his medical adviser in the East stating that the said patient has but a slight infiltration of the right apex. Careful examination, however, may reveal fine bronchial râles throughout the right lung besides signs of moisture at the top of the left. This experience has occurred so often with me that I have suspected that one of the early incidents of removal to a higher altitude is either the excitement of a bronchial catarrh, as indirectly it may produce a rhinitis, or that the climatic change has resulted in disclosing an extent of pulmonary involvement not before apparent, or both.

It is easily possible, of course, that the presumed effect of altitude upon the physical signs is imaginary, and only an illustration of the common circumstances that the same physical condition is variously described by different observers.

DISCUSSION.

Dr. SOLLY: I am sure we are very much indebted to Dr. Sewall for his paper. It opens up a great many very interesting points, too many for us to consider this morning. I fully agree with him in the statement as to what should be the foundations of our study and observation on the effects of altitude. The meterologic studies and the physiologic investigations should be made more complete. Incidentally, I may say that I hope we shall have before long a fully equipped laboratory at Colorado Springs, managed by skilled workers. While we are waiting for that more exact knowledge, we should, however, certainly take account of what we have. I would like to speak of Dr. Sewall's remarks about blood, and his reference to Professor Mosso's experiments. I think these were very unfortunate in many ways. His studies of the gases of the blood I am not competent to criticise, but his observations upon the effect of altitude upon respiration, circulation, &c., were imperfectly considered because he did not discriminate between those patients that had recently arrived at high altitudes and those who had been there for some time. The first essential of a study of these effects is to note this length of time, because physiologists all agree in the marked differences found between the immediate and permanent effects. The first marked thing in the difference of pressure is the immediate increase of blood in the peripheral vessels with a corresponding diminution in the deeper ones, but the permanent effect is an equalisation of the circulation, and you do not find there the extreme congestion of the peripheral vessels with diminished pressure or the reverse. One of the strongest clinical proofs of this is shown in the effect upon cases of arterio-sclerosis at high altitudes. Of course that has nothing to do with the dangers of sending cases of arterio-sclerosis to a high altitude, because such a patient is standing on the edge of a precipice at any high altitude, and a very slight indiscretion might serve to push him over. An increase of red blood cells is not only brought on by diminished barometric pressure but by many other influences, and it is not the immediate increase, but the permanent increase in the deeper as well as in the peripheral vessels that has to be considered. As to the effect upon the heart, I think Dr. Sewall is quite right in his general observations, but I think he has been too timid about the heart at high altitudes. It is very largely a question of what people do there. I have had a good many cases of very alarming congestion of the right heart where rest in bed and a milk diet has soon put them on their feet.

Dr. CURTIN: We know very well that cardio-tubercular cases do not generally improve at high altitudes, and I think it is due largely to the influence of this altitude on the nervous system. I think you will find some of the same symptoms at sea-level in emotional people. Speaking of their being so emotional and so exceedingly short of breath brings to mind the case of an Episcopal bishop who was under my care not long ago. As his condition improved and he was able to go out riding, he would become short of breath from watching the horse exerting itself in climbing a hill. Another man said that when he went out and saw a street car that he had been accustomed to overtake by running, his shortness of breath came on just from the remembrance of the fact that he used to hurry to catch it.

A great deal has been said about the delay of physicians in sending tubercular cases to climatic resorts. I think it only just and proper to say that the majority of patients do not go to a resort as soon as they are first advised. They often delay months, or even a year, before making up their minds to go, and the physician who was aware of the danger of delay is blamed because the patient does not improve.

Dr. SEWALL: My reference to the blood count as changed by altitude was simply in illustration of the complexity of these biologic problems, and I was using the simplest case I could think of. We know a great deal about the heart physiology, but probably only a fraction of the truth, so I say that in a series of hearts which we call organically normal there may be an infinite variety of power. Take two men that look alike and are of the same physique, and one will be able to make a long tramp at a high average number of miles per day, while the other will break down perhaps on the third or fourth day. What I wanted to urge upon my colleagues is this, that when patients at a high altitude do not do as well as we think they ought to, we should suspect the heart, and by paying attention to this I think we may save some lives.

THE NERVOUS CARDIAC SYMPTOMS OF HIGH ALTITUDES.

BY F. SAVARY PEARCE, M.D.
PHILADELPHIA.

It was my privilege last year to present the subject of the "Influence of Climate upon Nervous Diseases considered from a Physiological Standpoint,"* in continuation of a series of studies first begun during extended travel through New England, Canada and the West, and first brought together in a paper entitled "The Climatology of Neurasthenia,"† presented before the Medical Society of the State of Pennsylvania, September, 1900. It has been satisfactory to see that the line of thought presented has met with some approval by the profession. The interest of the subject is only surpassed by the difficulty of determining accurate scientific facts. Nevertheless we feel that certain physical conditions obtaining as regards atmospheric pressure, winds, altitude, &c., materially influence the normal human body and also very much more pronouncedly the sufferer from disease, particularly diseases of the nervous system, functional or organic.

The Effect of Altitude upon the Heart in Normal People.—The physiology of the normal person is so nicely adjusted and resilient, so to speak, that changes of altitude in healthful

* *New York Medical Journal*, October 5, 1901, and vol. xvii. of *Transactions of the American Climatological Association.*

† *Medical News*, January, 1901, and *Transactions of the Pennsylvania State Medical Society*, 1900.

countries, when not made suddenly and not of too great height, say up to 5,280 feet, about that of Denver, will certainly not be found to disturb them in the least. This I have had noted from personal experience and from that of many others; and even at the altitude of Las Vegas, New Mexico, which is 6,398 feet above sea level, I have known normal people who experienced no discomfiture whatever. At the altitude of Pike's Peak, over 14,000 feet, we all know from our friends who have visited that height that disagreeable sensations and palpitation of the heart occur in many. The tendency will be, however, as we ascend to produce a more easily excitable heart in normal persons, due, in a measure, to the increased peripheral circulation through the lessened *vis a fronte*. This, continued through generations, may in turn be the cause of dwarfism, as shown in the Thibet men—likely on account of the fact that the important organs of body metabolism, as the liver, are less constantly kept flushed with fresh blood, and therefore the important chemical changes necessary for bodily growth do not occur. *A priori*, it seems patent that the best type of human physical being will be from a stock whose lineage has for many generations lived by hard manual work, associated with acute mental calculations; and on moderately high plains, as in our Western States, at the foot-hills of the Rocky Mountains. The theory recently promulgated by Loeb and Matthews tending to prove an electric energy as nerve force, if ultimately found to be correct, may awaken renewed investigation towards solution of this perennially interesting problem of functional nervous disease, and therefore functionally perverted action of the heart here considered.

The Effect of Altitude upon the Heart in Functional Nervous Disease.—Since so much of the successful treatment of disease of the mind and nervous system depends upon remedial measures to which drugs are the important adjuncts, it falls true that changes of season, climate, &c., are the fundamental conditions controlling many diseases. Considering the subject

in hand, *i.e*, the possible affection of the heart due to altitude, we have to bear in mind at first that the nervous heart so-called is entirely dependent upon the condition of the nervous system; and that in neurasthenia, for example, the rapid irritable heart is a frequent accompaniment. The conclusions we drew as to the latter disease will still be in force for the "irritable heart," viz., "It is almost axiomatic that an altitude of over 2,000 feet is unsuitable for the neurasthenically disposed or convalescent patient. Any very 'stimulating' climate should be avoided. Other conditions to be avoided are as follows: Districts menaced by high winds and frequent fogs; cloudy saturated atmospheres with but slight movements of air, low country (sea level) with continuous, non-varying although moderate heat. Thus the Bermuda Islands and Florida are enervating localities. Ideal conditions for the neurasthenic include sea air in a well-wooded country far enough from the coast to avoid its fogs. A sea voyage is, as a rule, an excellent preliminary to other climatic measures. Provided the voyage be not stormy, it acts both physically and psychically in soothing the nervous system. In order to obtain the full benefit of correct climatic conditions the patient must have good food. Without this important adjunct the desirable climatic change may be entirely defeated in its effect on the patient."

The paper on the "Blood Count in High Altitudes," read before the Association at Niagara Falls by Dr. W. A. Campbell, assisted by Dr. H. W. Hoagland, gives some further clue to the solution of mechanism of the effects of high altitudes upon the cardio-vascular system, and as stated in the discussion of that paper, the writer still believes that the sensible perspiration carrying off much of the waste products of the body is of benefit to nervous individuals when autointoxication is coexistent. Also that at high altitudes increased sensible and insensible perspiration occurs according as the air is moist or dry, and that as a rule, therefore, the cases of idiopathic nervousness or essential neurasthenia will do better at the lower altitudes suggested.

The decrease of atmospheric pressure at altitudes above 6,000 feet certainly does in some way unknown as yet tend to weaken the inhibitory ganglia of the cardiac muscle. Yet it will not be fair either to compare physical experiments with actual facts as determined by clinical observation of the effect of heat loss, since the human body is entirely different from any inorganic mass; hence if in a phial of water it be found that the liquid loss is more rapid at sea level, the human body will do likewise. The element of complete metabolism is so interwoven with health that the effect of height with its associated winds and temperature will prove of value only as they are constant and active agents towards a better internal absorption of food products. Nor is it necessarily so that an irritable heart which the patient describes will ultimately prove to be an irritable heart by the *continuance* of the climatic conditions, among them altitude, which seems to be and indeed is, often the etiological factor for this condition. It may be in some cases that this disagreeable affection of the cardiac muscle will have to be gone through with before the patient can come to a fundamental condition of good health. I have a case at the present time of a young lady suffering from hystero-neurasthenia with disagreeable and at times dangerous herpetic eruption upon the vocal bands where Dr. E. B. Gleason excluded any organic disease of the vocal cords, and where rest treatment associated with mental therapeutics had bettered her condition much. I sent her to Las Cruces, New Mexico, at an altitude of 3,730 feet above sea level, where an irritable condition of the normal heart-muscle was nicely shown to have been produced within a week; although her general nervous condition, it may be stated, was definitely improved, probably due to the dryness of the atmosphere itself. A letter received May 26, 1902, gives a better report, namely, that the heart symptom has abated, her condition of general nervousness much improved and the attacks of laryngismus almost cured. It has taken about ten weeks for the young lady to become accustomed to the great

physiological change in her system, and it will be my advice to continue for a year or so in the climate and altitude which seem now to be doing great good. An analysis of this case would seem to justify the conclusion that the neurasthenic condition was an *essential* one, *i.e.*, not due to any tangible toxic or other cause, and that the altitude of over 3,000 feet, which, as I have already stated, is not, as a rule, good for the nervous individual, or his cardiac symptomatology, must have in this patient through the dry atmosphere favoured better metabolism and lessened the expenditure of nerve energy in that direction. I would say that, in a simple case of neurasthenia with irritable heart, a patient will usually experience considerable palpitation and cardiac distress when ascending above 2,000 feet; but, if high winds do not prevail, I conclude that the patient will be ultimately benefited if the general nutrition improves as shown by gain in weight taken in actual week-to-week records. In that enigmatic disease hysteria alone, the effect on the heart will depend, therefore, very much upon the tendency towards normal metabolism produced at high, dry altitudes. It has been my experience, too, in partial proof of this that people living at moderate heights in the coast region or mountains in the north-western United States, at a moderate altitude of 1,000 to 1,500 feet, have more quickly and permanently produced palpitation and tachycardia, due undoubtedly to less active metabolism in this moist climate. At an altitude of 2,000 feet, as at Tim Pond, Franklin County, Maine, the dryness of the climate produces the better effect in nutrition, and nervous people there do not experience any cardiac distress; while in the same altitude in the Adirondacks, associated with greater moisture, it will be unfavourable to nervous disease and irritability of the heart action, which has been found by me to be a prominent feature of the cases studied in the Empire State. The pine regions of Georgia and North Carolina, back from the coast and at an altitude of somewhat less than 2,000 feet, do not produce any nervous cardiac symp-

toms; while the damp low country in Florida will produce both mental distress and a subjective feeling, at least, of cardiac distress.

Effect of Altitude upon the Heart in Organic Disease of the Nervous System.—The affection of the heart in organic diseases will depend upon the site of the lesion in the brain or cord, and in affections of the cardiac muscle or endocardium in association. Taking first the sclerotic diseases of the cord, it is certain that the heart regulating mechanism will be more profoundly disturbed in these diseases, particularly ascending scleroses, as in the cases of amyotrophic lateral sclerosis, glosso-labio-pharyngeal paralysis, or even in cases of chronic multiple neuritis, wherein by continuity of the inflammatory process the pneumogastric or phrenic nerves may be susceptible to the continuance of inflammation to them, and therefore to pneumo-cardiac control.

Any change of altitude is, therefore, to be very carefully considered in relation to the rhythm of the heart, the absence of cardiac disease, &c. With a normal heart and degeneration of the lower cord, as in tabes, a moderate altitude as of 2,000 feet will do good only in relieving the heart from over-work through the increased peripheral circulation; therefore, in any organic disease of the brain or cord, in the writer's opinion, high altitudes should be eschewed for the reasons given. The effect of altitude upon disease of the heart seen in general medicine will be favourable in cases of hypertrophy, it seems to me, when due to resistance in the course of the circulation peripheral to the capillaries, as in Raynaud's disease and angio-neurotic œdema. In disease of the endocardium, as in valvular disease without loss of compensation, moderate altitude should be insisted upon. In cases in which there is loss of compensation, as shown by œdema, chronic gastritis, renal congestion, &c., an altitude of 2,500 feet or more in a dry climate will undoubtedly prove of value in the majority of cases. Cyanosis, therefore, is not always a contra-indication to moderate altitudes.

It is not considered necessary to urge here the importance of the hygienic bearing of the case of heart disease in any altitude, and especially is this desirable to be kept in mind by the physician when the patient changes his environment. Emphysema, particularly if associated with asthma, will often be benefited by the high, dry altitudes, since the interchange of oxygen by the more rapid respiration induced will the better oxygenate the blood, and in this wise relieve the over-acting heart-muscle.

Prognosis and Treatment.—In cases of heart disease these will be more certainly determined and perhaps materially changed when recognition shall have been given to this important branch of climatology presented for your consideration.

WHEN SHOULD THE CONSUMPTIVE RESIDING IN COLORADO BE PERMITTED TO RETURN HOME?

BY SHERMAN G. BONNEY, A.M., M.D.
DENVER, COLORADO.

THE limitations of the subject preclude the introduction before this Society of other than brief preliminary suggestions, in accordance with which may be elaborated principles capable of special application. It is with much hesitation that these remarks are offered as affording the merest elementary outlines for this purpose.

This subject relates not to those with hopelessly advanced tuberculosis, whose claim for a return home is based largely upon humanitarian grounds, but rather does it refer to the more favoured class who succeed in securing ultimate arrest. To such the question is of vital importance, and its answer attended with far-reaching results. A high degree of moral as well as professional responsibility attaches to the position of the medical adviser. His obligation takes cognisance not only of the relation between the future physical possibilities of the invalid at home and in Colorado, but also the association of certain other distinctive and often exceedingly important considerations. Briefly illustrative of these peculiar attendant circumstances are to be mentioned radically changed business prospects, severance of existing social relations, and dismemberment of families. A subject presenting so many diverse and delicate phases, obviously incapable of generalisation, demands in the determination of its

final adjustment a duly proper time and consideration of its several factors, in conformity with which should rest the special analysis of the merits of individual cases. The object of this paper is to present a few elementary yet fundamental principles worthy of such detailed application.

It seems fitting to preface this discussion by a few plain statements of fact relative to the oft-repeated assertion that consumptives should not be sent to high altitudes on account of their alleged inability to return home with safety after arrest has been secured. The argument that has been adduced has been to the effect that a residence in high altitudes, with the resulting vesicle dilatation, renders the invalid unduly susceptible to reinfection or reactivity of the tubercular process upon return to previous climatic conditions, and hence should preclude recourse to a most valuable agent in the treatment of a dangerous disease. Were this contention true, which is, however, emphatically denied, it still could not be considered as an argument against sending patients to elevated regions but only against permitting them to return. The essential obligation would still be, not a regard alone for the patient's welfare after recovery, but a determined effort to promote recovery in the manner affording the most reasonable assurance of success. It is solely with a view to its relative value in securing an ultimate and complete arrest that should be considered the practical utility of any phthisio-therapeutic agency. To this end the intrinsic advantage of altitude, with other conditions of dryness, sunshine, and atmospheric purity, should take precedence over any fancied objection supposed to take effect, even if true, only after the patient is cured. It is not a question as to the locality or manner in which the ultimate arrest is effected, but simply as to the actual accomplishment of this result, which once secured must be equally as true and complete if secured in health resorts as in home sanatoria. The very conception of the desired result as well as its clinical demonstration permits no difference in degree according to the location or method of its attainment. The

simple existence of conjoined climatic and other conditions permitting the development of the disease imply at once the expediency of a radical change from these influences; but an arrest obtained in a new country is no less an arrest than if secured at home. This having been once obtained regardless of climate, the force of the argument applicable to all alike relates to whether or not the patient return to the same environment, occupation, climate and mode of living which have conspired to render possible his misfortune.

If *all* the conditions remain in force, he may be expected to suffer the likelihood of a repetition of their continued effect. By as much as these unfavourable conditions are improved by just so much is the danger of their deleterious influence diminished upon the individual with previously impaired resistance.

In pursuance of this line of thought, it cannot be doubted, in the absence of certain special considerations, that it is better for the invalid to remain under the conditions that have conduced to his recovery from a formidable disease than to return to the same combined treacherous influences that have sufficed for its development.

Appreciating the definite place that must unavoidably be ascribed to climate in the scale of predisposing causes and recognising that in all cases it must constitute at least one factor worthy of due consideration, it would seem, in view of the great comparative rarity of the development of consumption in certain localities, that its influence should be reckoned with in subsequent advice to all arrested cases, equally worthy of consideration by those improved at home and those away. In accordance with this reasoning was prompted one of my conclusions in a paper presented before this Society five years ago, viz., that "patients should come early and come to stay." Without receding from the general correctness of this advice, it is nevertheless true that a portion of so-called cured cases in Colorado can be permitted to return home under certain conditions and

instructions, with a minimum degree of danger, just as from local sanatoria. If such cases are carefully and ably selected by the physician himself and by no means in accordance with the inclinations of the individual, there can exist no reason why this step is not as permissible from Colorado as from less elevated regions. It is simply a question for such a class as to how much risk they are willing to assume. A degree of danger must exist in any event, as, no matter how perfect the manner of life and the surroundings, there must remain lacking one of the important elements of continued preservation. It is well for the consumptive to be made to understand that, once the tubercle bacillus has selected his person as an habitat, his life should become materially changed in all its essentials in any climate, and that this is less true in favoured regions than at home. Although often a severe test of his resignation and fortitude, a fortunate choice of climate in the beginning and continued residence therein imposes ultimately less of sacrifice and suffering.

To those to whom a tentative return home seems justifiable, this advice should be rendered with strict reference to a detailed consideration of all the factors of the individual case.

It has been my custom in giving such advice to do so only after a comprehensive review of the situation with the patient or his family, and the placing of a portion of the responsibility where it belongs upon them. Final permission to return home has been accorded upon the basis of the following general considerations applied to special cases.

(1) General climatic conditions existing in the locality of previous abode with special reference as well to the particular time of year in which return home is contemplated.

(2) The location of residence, whether in city or country, including such details of its immediate surroundings as the relative degree of atmospheric contamination, open-air space, character of soil, amount of sunshine, comparative elevation, proper accommodation, ventilation and other interior conditions.

(3) The future environment of the individual, which embraces

a review of his financial status, and ability to live according to instructions, the degree of the responsibilities necessarily to be assumed, and the energy to be expended, the domestic relations, including the size, character, and *personnel* of the family, with the various obligations imposed, and the presence or absence of sympathetic co-operation.

(4) The age, intellect, will and temperament of the patient as determining to what extent the educational influence of his stay in Colorado can be expected to modify a previous mode of living and ensure future conformity to hygienic laws and detailed instructions.

(5) A review of the conditions under which the disease originally developed, relating especially to out-door opportunities, habits, and occupation, mode of life, and possibilities of contagion. All of these, if shown to have no direct bearing upon the special case, must emphasise the important influence of climate. On the other hand, any single factor or several combined may assume such a predominating position in the etiology as to almost transcend the climatic consideration.

(6) An estimate of the degree of individual resistance, as exhibited in the family and previous history, manner of onset of the disease, its subsequent course before arrival, and the character of its clinical manifestations in Colorado before ultimate arrest is secured.

(7) As implied in the preceding, the attainment of apparent complete arrest of the tubercular process, this not assumed by virtue of absence of cough or expectoration, or fever, by gain in weight, no matter how great, by improvement in strength, colour or spirits, even if in excess of any former condition, but in addition evidenced substantially with reference to physical signs.

(8) The disappearance and continued absence of moisture within the lungs following a forced cough as constituting cessation of apparent tubercular activity.

(9) A period of at least six months' residence in Colorado

following both the constitutional and physical evidences of total arrest.

It seems unnecessary and pedantic to further elaborate the foregoing brief considerations. For the purposes of this paper it has been perhaps sufficient to enumerate the general considerations through the detailed application of which is afforded a fairly safe and rational answer as to when the patient can be permitted to return home.

If these elementary principles are rational and correct they must not only be pertinent to Colorado, but applied with equal force to all health resorts and sanatoria.

THE SANATORY TENT AND ITS USE IN THE TREATMENT OF PULMONARY TUBERCULOSIS.

BY CHARLES FOX GARDINER, M.D.

COLORADO SPRINGS, COLORADO.

THE cure of consumption, to-day rests absolutely upon one great factor in treatment, and that is—outdoor air. Any method by which a consumptive can breathe outdoor air, day and night, without exposure and without fatigue, and surrounded by the comforts, or even luxuries so necessary to the invalid's existence, should be warmly embraced by all who are interested in the cure of this terrible disease.

Such a method I believe I have devised by the use of my Sanatory Tent, which has been the result of considerable study and much practical experience during the last ten years. It seems to be a strong impression in most lay, and some professional, minds, that if the windows of an ordinary room are opened wide, all the conditions of ventilation are then sufficient for the pulmonary invalid. This is a great mistake and has undoubtedly caused many unnecessary deaths. Window ventilation of a room does not cause as rapid an air interchange as it should, for several reasons. If such a window faces the wind the air is forced into the room, but vitiated air is not forced out; while, if the wind is from the other direction or blowing away from the open window, the air interchange depends entirely upon suction. If two windows are used opposite each other a strong draught is created, while still the corners of the room collect stagnant air.

On a piazza conditions are more favourable, but even here much remains to be desired. If the piazza has a roof and side curtains, these curtains have to be lowered in stormy or windy weather; there is no outlet in the roof for foul air to escape, and we are practically imitating the bad features of a room under the impression that we are living outdoors. This does not apply to every porch or piazza, but is true of many. On open porches, such as invalids sit upon during the daytime, the difficulty is that they are too light, windy or cold, and if a rest is needed, or if on any pretext the house is entered, the temptation to be warm and comfortable is so hard to resist that much valuable time is lost.

These defects of room and piazza ventilation, of course, are obviated to a large extent in properly equipped sanatoria, and the results of these institutions in curing tuberculosis leave nothing to be desired. But a very small percentage of tubercular cases are ever treated in sanatoria; and I am speaking of that vast number of invalids who are trying to get well under the direction of a physician in their own homes, or in boarding houses or hotels at some health resort. Such cases we all know are very hard to control. In a sort of a perfunctory way, we tell them to live outdoors and be in the open-air as much as possible, and the actual result is, that out of twenty-four hours about four to six are spent on the piazza and the rest indoors. We ought to make a strong effort to utilise every hour of the twenty-four. Sleeping or awake, such patients should constantly inhale fresh outdoor air. The only way to achieve this is to arrange so that they will take it unconsciously and not as a task to be performed like a lesson learned. By far the best way in climates at all favourable, in my opinion, is to have them live in a sanatory tent, where they are surrounded by their comforts, where they can go to bed or sit up, where they do not have to depend on opening any windows for good fresh air, and where, if they are cold, they do not have to be loaded down by furs, with a hot bottle

between their feet, but can live in a temperature of 60° or 70° with the perfect assurance that the air interchange is as rapid as if they were actually outdoors. This, to me, is a very essential point, and I have found that in Colorado it is practicable, and cures cases of tuberculosis that were doing badly when living in rooms and sitting on porches daily.

The invention of the sanatory tent was a slow process of evolution from a primitive and simple form which I copied from the Ute Indians. I noticed that in their "tepees" of

skin the ventilation was nearly ideal. The reason for this was, they used a conical tent with a hole in the point of the top for the escape of smoke and plenty of space around the lower edge, where the tent rests upon uneven ground, for air to enter it. In this way the "tepee" acts like an inhabitable

chimney or fire-place, and, although in such an Indian home there are, of course, atrocious odours of all kinds, I have noticed that the actual ventilation is much better than in ordinary tents generally used by invalids.

Taking this hint from the Indians, I constructed a tent of canvas built like an Indian "tepee," which answered the purpose fairly well. I next used a circular floor with an open space all about the edge for the air to enter, still retaining the opening at the top of the tent for the heated and bad air to pass out. My tent, as now made, is of dark khaki twelve-ounce duck, stretched over a six-sided framework of wood, without any centre pole and without pegs and guy-ropes, so that it stands firm, like a house. The floor is raised eight inches from the ground, and is in six sections, so that it can be easily moved. The lower edge of the wall is fastened several inches below the floor, and one inch out from it all around; this is to insure at all times an inflow of air that is gradual and without draughts, since this inch space in a circular tent represents an area of 520 square inches, and the hole in the top for overflowing air has an area of some 177 square inches. In this way the tent cannot be closed, and is ventilated automatically and constantly. In other words, this is a circular tent with the bottom of the canvas forming a circle around the wooden floor, and also extending a little below. The open space between the floor and the walls of the tent allows air to flow in at all times, while the hole in the apex, or top, allows air to flow out all the time. In this way the tent always ventilates itself day or night, whether the door is shut or not, whether the interior is heated or not, or in any weather. As the air has to turn a corner to enter the tent, it cannot come as a draught, and as it passes in through all the inch space encircling the floor, it enters slowly and without force, being evenly distributed, but coming through, collectively, a large area. There are also small shutters so constructed that they can partially close the opening from within the tent in case of very high winds. The

opening at the top of the tent is covered by a zinc cone which can be controlled by pulleys and rope within tent, in stormy weather being drawn to within an inch of the tent roof.

My tents are heated by central draught circular stoves which burn either wood or coal, and can be so regulated as to keep a good fire without care for ten hours. Even in zero weather the tent can be kept perfectly comfortable to dress or undress in, or to sit still and read. The stove is of such a size as to thoroughly warm the tent under any conditions, and at the same time it is impossible to overheat the air or interfere with ventilation. The more heat used, the greater the displacement of heated air upward, and a more rapid interchange of air at once occurs. As the heated air can escape at the top, the fresh air can always enter at the bottom of tent. This is automatic and is not under the control of the invalid. These facts I wish to emphasise, as they are of very great importance. The average invalid has an aversion to ventilation and will shut windows and in other ways embarrass the inflow of fresh air. In the sanatory tent it is impossible to do this as they are ventilated automatically. The stove-pipe passes out through the wall of the tent and by an elbow-joint is carried upward to the height of the tent. It should be made of galvanised iron, and can be guyed in place; it must not be below the top of the tent in order to insure good draught, and, in burning wood, to lessen danger from sparks.

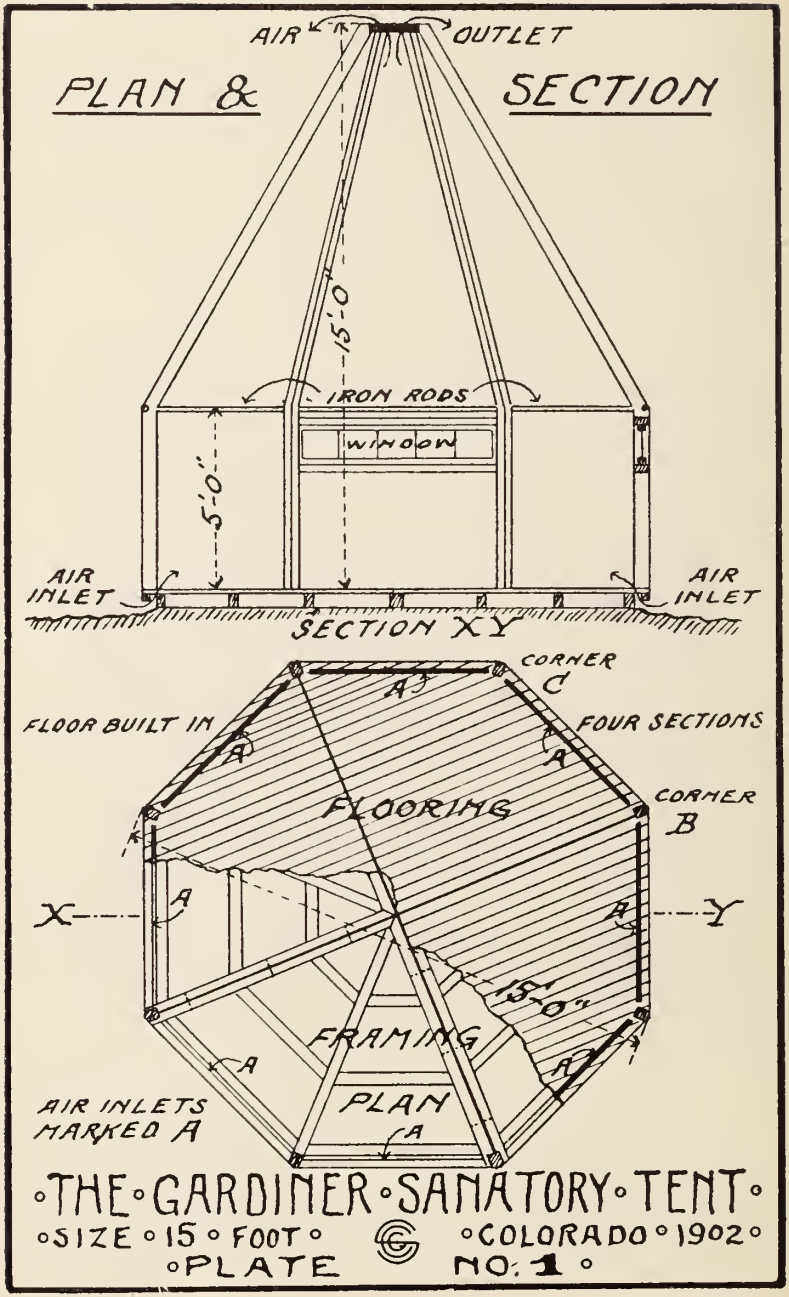
A small window which does not open is used in these tents. It is placed horizontally and is 1 ft. by 6 ft.

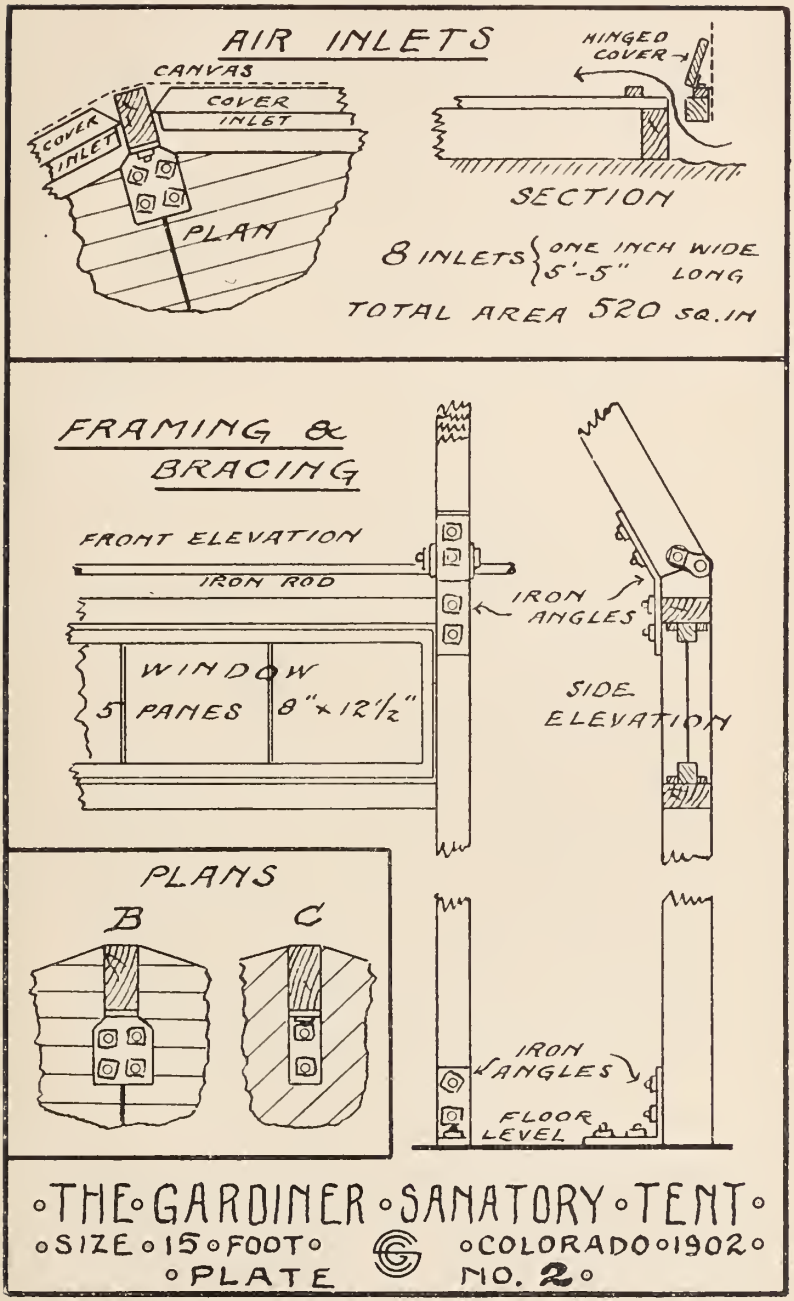
It is most essential to have this tent furnished as completely and as comfortably as a bedroom. A proper bedstead (preferably of iron) with a thick mattress and plenty of covers; a shelf with hanging curtains on both sides and ends, for hanging clothes; a washstand and bureau; if possible, a commode; a box for coal and wood; a shelf for bottles and one for books; one or two good rugs on the floor; a steamer-chair; an armchair, and a table for writing. These need not

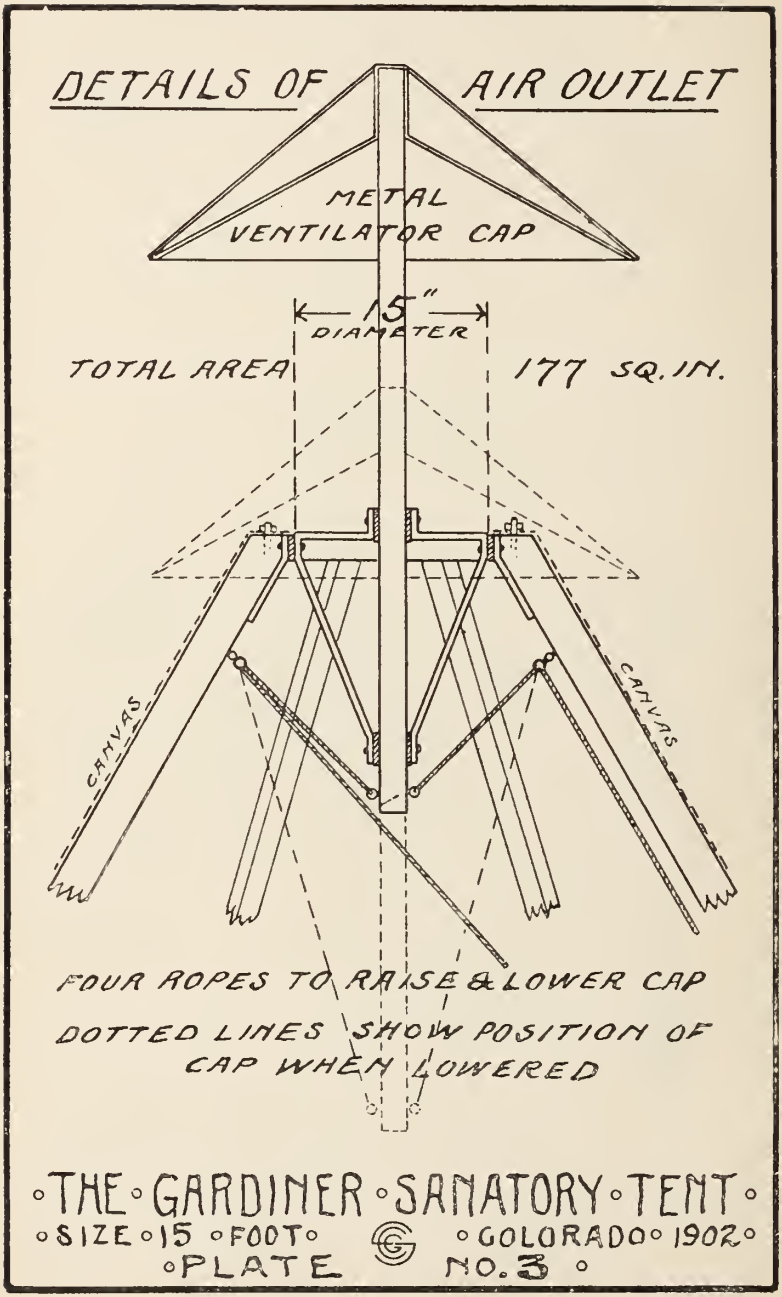
be expensive, but simple and strong. A scrap-basket, broom, a dust-pan, a hammer and some nails, and a little saw frequently come in useful. In come cases I add a little zinc-lined box having two compartments, one of which is filled with ice and the other used to keep milk, eggs, &c., cool. The lighting of the tent, if possible, should be by an electric wire taken from a near-by house; there might also be an electric bell to ring in the house.

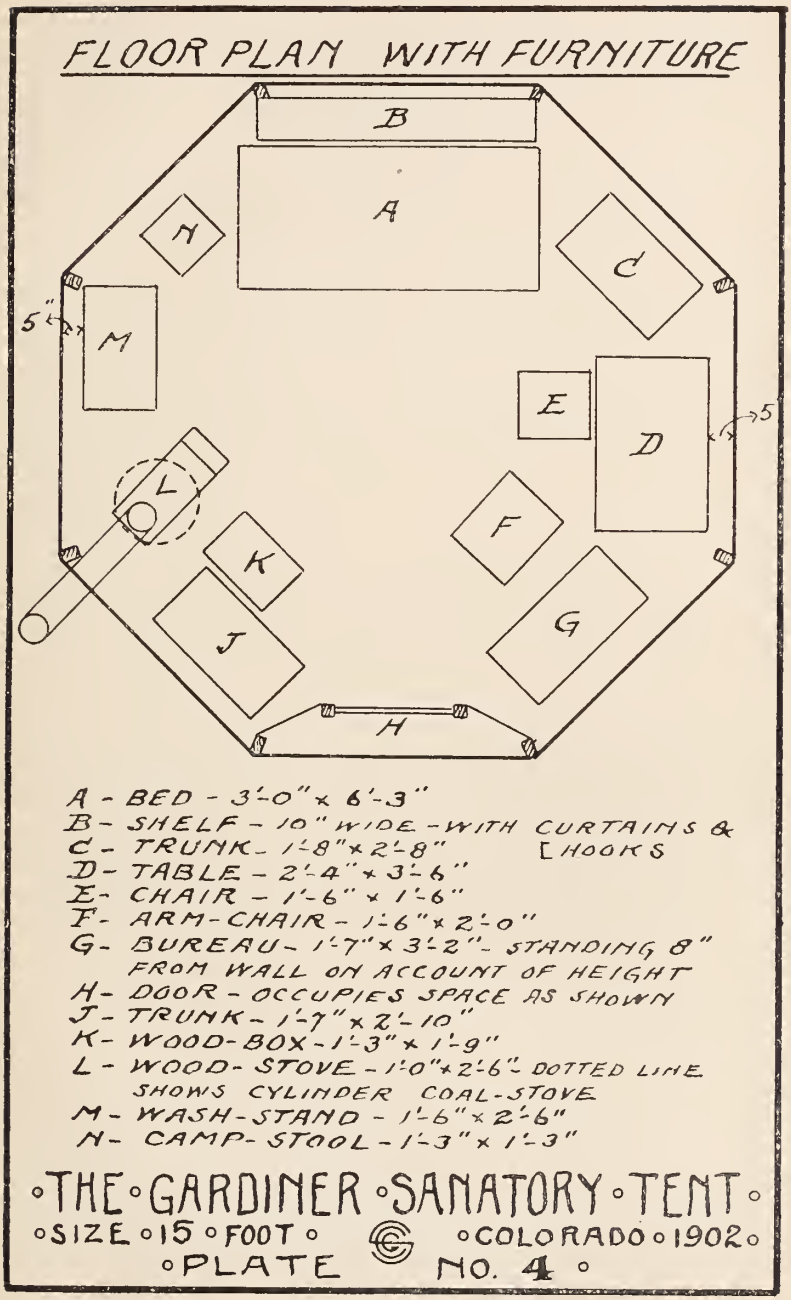
In addition to the furniture belonging to the tent, I generally have made to use outside an awning, 12 by 10, stretched upon four uprights under which a hammock, chair and table can be placed.

The tent is made of dark brown duck which does away with the white glare of light in the morning so disagreeable


AIR
OUTLET
PLAN &
SECTION
15'-0"
IRON RODS
WINDOW
5'-0"
AIR INLET
AIR INLET
SECTION XY
CORNER C
A
FLOOR BUILT IN
FOUR SECTIONS
A
A
CORNER B
FLOORING
X
A
A
Y
15'-0"
FRAMING
A
A
PLAN
AIR INLETS MARKED A
A
THE GARDINER SANATORY TENT
SIZE 15 FOOT
COLORADO 1902
PLATE NO. 1


AIR INLETS
CANVAS
COVER
INLET
COVER
INLET
PLAN
HINGED COVER
SECTION
8 INLETS { ONE INCH WIDE 5'-5" LONG
TOTAL AREA 520 SQ. IN
FRAMING & BRACING
FRONT ELEVATION
IRON ROD
WINDOW
5 PANES 8" x 12½"
IRON ANGLES
SIDE ELEVATION
PLANS
B
C
IRON ANGLES
FLOOR LEVEL
THE GARDINER SANATORY TENT
SIZE 15 FOOT
COLORADO 1902
PLATE NO. 2


DETAILS OF AIR OUTLET
METAL
VENTILATOR CAP
15"
DIAMETER
TOTAL AREA 177 SQ. IN.
CANVAS
CANVAS
FOUR ROPES TO RAISE & LOWER CAP
DOTTED LINES SHOW POSITION OF
CAP WHEN LOWERED
THE GARDINER SANATORY TENT
SIZE 15 FOOT
COLORADO 1902
PLATE NO. 3


FLOOR PLAN WITH FURNITURE
B
A
N
C
5"
M
E
D
5
L
F
K
G
J
H
A - BED - 3'-0" x 6'-3"
B - SHELF - 10" WIDE - WITH CURTAINS & HOOKS
C - TRUNK - 1'-8" x 2'-8"
D - TABLE - 2'-4" x 3'-6"
E - CHAIR - 1'-6" x 1'-6"
F - ARM-CHAIR - 1'-6" x 2'-0"
G - BUREAU - 1'-7" x 3'-2" - STANDING 8" FROM WALL ON ACCOUNT OF HEIGHT
H - DOOR - OCCUPIES SPACE AS SHOWN
J - TRUNK - 1'-7" x 2'-10"
K - WOOD-BOX - 1'-3" x 1'-9"
L - WOOD-STOVE - 1'-0" x 2'-6" - DOTTED LINE SHOWS CYLINDER COAL-STOVE
M - WASH-STAND - 1'-6" x 2'-6"
N - CAMP-STOOL - 1'-3" x 1'-3"
THE GARDINER SANATORY TENT
SIZE 15 FOOT
COLORADO 1902
PLATE NO. 4

in most tents. The floor of the tent is about eight inches from the ground so there is very little fear of dampness. It is, of course, more comfortable and practical for an invalid to live in this tent during the winter, in a climatic dry belt such as Colorado, Mexico, Arizona, some parts of California, &c., but they have been used with success in Massachusetts, Oregon, New York, and probably in many other places.

The inherent idea, common to many minds, that during the cold months living in a tent must necessarily be a hardship is difficult to overcome. A tent generally brings up the picture in one's mind of cold, dust, wet, flies, glaring light, and, in general, the usual experiences one has on a camping trip. But in a sanatory tent, especially if any degree of common sense and care is used to have the tent in the shade during the summer, these discomforts are not felt, and invalids assure me that they are quite as comfortable as in a house. I know many invalids living in the average boarding-house room at health resorts who are certainly not as comfortable as they would be in the sanatory tent, either day or night. It is furthermore not a theory, but a proved fact, this sanatory tent having been in actual use for two or three years and under different conditions of climate. Not only have insipient cases done well, but those far advanced with cavities have had fever diminished and general improvement occur. In several instances these patients had been living in ordinary tents from a year to two years without benefit, and after living in a sanatory tent have, within a short time, improved in weight and strength.

The ventilating system of the sanatory tent construction can also be utilised in a building made entirely of wood. A small six-sided or circular house could be made of timbers and shingles, with a sharply pitched roof and an opening in the top to allow of outflowing air, while the floor of such a building could be so constructed as to leave an open space of one inch all around inside the walls for fresh air to flow in constantly. Such a building could also be heated by an open fireplace,

or stove, or steam; or hot water could be conveyed to it. Such a house could be comfortably furnished and have doors and windows, and, by utilising all the sanatory features of the tent, would, in addition, be much more durable and possibly be available for many invalids in damp climates during the winter months who could not be induced to live in a tent of any kind. Also, these sanatory tents, or, if preferred, sanatory tent houses, can be used as part of a general sanatorium; a main building being constructed as a heating, dining, and administration building, which could be surrounded by those tents. In this way they would be as practical as the present cottage system at far less expense, and patients living in them could be assured of a supply of outdoor air, which in purity and quantity would far excel that obtained in the ordinary sanatorium cottages.

I wish to acknowledge my indebtedness to Mr. George Southard who has very kindly made the sectional drawings of tent construction, and also took two of the photographs.

NOTE.—The actual construction of these tents can be much better understood from the drawings and figures which are here shown than by any description. The view of the tent interior represents a dome of canvas which divides the tent into two parts, but allows of a wide space at the edge of dome for air to pass upwards by the wall of tent. This economises heat and is used in very cold weather. I have allowed the Colorado Springs Tent and Awning Co. to patent my invention of the sanatory tent, and I derive no pecuniary benefit from their construction and sale.

IMPRESSIONS OF DIFFERENCES IN PRACTICE AT LOW AND HIGH ALTITUDES.

By WILL H. SWAN, M.D.
COLORADO SPRINGS, COLORADO.

THOSE physicians who for any reasons have found it desirable to change their field of labour from a low altitude to a high one, have doubtless been on the look-out for any differences in the behaviour of disease or normal conditions in the two localities.

In any investigation what is desired is *facts*; and to get at any such differences in a definite and conclusive way would first require carefully made physiological comparisons of the conduct of the various vital functions in the different localities. Probably conditions arrived at by any other method would be fallacious and inconclusive. Yet many of our ideas in life are based on beliefs or impressions, and where definite, proven knowledge is impossible, beliefs and impression must be the basis of our ideas.

With this limitation in mind and for the purpose of getting evidence from physicians who had had opportunities for comparisons, the writer addressed a circular letter to 392 physicians, members of the Colorado State Medical Society and of the Rocky Mountain Inter-State Medical Association, asking their impressions as to any differences they had noted. These Societies have their membership from Colorado, New Mexico, Arizona, Utah, Idaho, Wyoming, and Montana.

However inconclusive and fallacious the deductions from

this evidence may be, in the hope that it may serve as an introduction to a discussion or comparison of ideas by members of this Society, the writer will give a summary of the replies.

There were received 199 replies; 86 of these were thrown out of consideration for various reasons, leaving to be considered 113 replies.

There was evidently some confusion as to the meaning of certain questions, and consequently some uncertainty in the replies to them. The writer realises the difficulty in stating one's meaning clearly and fully in such an arbitrary and succinct manner, either in asking questions or making replies; but for obvious reasons, more voluminous statements could not be asked.

As to the altitudes at which these men formerly practised: Eighty-four came from altitudes between sea-level and 1,000 feet; sixteen came from altitudes between 1,000 feet and 2,000 feet; six came from altitudes between 2,000 feet and 3,000 feet; six came from altitudes between 3,000 feet and 4,000 feet.

They are now practising at altitudes indicated as follows: Between 3,000 and 4,000 feet, two; between 4,000 and 5,000 feet, twenty; between 5,000 and 6,000 feet, fifty-three; between 6,000 and 7,000 feet, twenty-seven; between 7,000 and 8,000 feet, five; between 8,000 and 9,000 feet, four; between 9,000 and 10,000 feet, two.

In order to avoid repetition, I will read the letter and questions, with the summary of replies, and some personal comments will be made later.

"Colorado Springs, ...

"DEAR DOCTOR,—For the purpose of publishing results, I am endeavouring to get from a large number of physicians their impressions of the differences in medical practice at a low altitude, and at an altitude of 4,000 to 10,000 feet.

"I say 'impressions,' because in most of the following questions it would be impossible to state proven facts.

"Will you kindly answer the following questions and state whether you see the conditions mentioned below more frequently, or less so, than formerly, at a low altitude?

"Thanking you, ...

"WILL H. SWAN."

	More.	Less.	Yes.	No.	No difference.
Biliousness, or other digestive disorders?	52	96	...	...	5
Lithæmia?	44	35	...	...	...
Does Urinalysis show more frequent excess of urates or Uric acid? ...	...	...	56	28	...
Rheumatism { Acute?	51	45	...	...	...
Rheumatism { Chronic?	35	54	...	...	...
Do heart affections occur more frequently during the course of acute rheumatism?	...	...	30	60	...
Nervousness?	23	9	...	...	...
Do the cases do as well at a high altitude?	...	...	24	61	...
Hysteria?	21	12	...	...	...
Do the cases do as well at a high altitude?	...	...	38	44	...
Chorea?...	15	14	...	...	...
Do the cases do as well at a high altitude?	...	...	42	42	...
Neurasthænia?	17	9	...	...	...
Do the cases do as well at a high altitude?	...	...	31	55	...
Migraine?	9	19	...	...	...
Do the cases do as well at a high altitude?	...	...	50	31	...
Insomnia?	19	12	...	...	...
Do the cases do as well at a high altitude?	...	...	35	64	. .
Do wind or dust storms increase nervousness or insomnia?	...	...	95	15	...
Do heightened electric conditions increase nervousness or insomnia?...	...	...	75	20	...
Acute lobar pneumonia?	19	15	...	...	...
Is breathing more embarrassed? ...	...	...	64	28	...
Are cardiac complications more frequent?	...	...	50	43	...
Does the crisis occur earlier? ...	...	...	39	47	...
Is it more fatal?	...	...	60	33	...

	More.	Less.	Yes.	No.	No difference.
Is convalescence more rapid, or less so?	48	24	...	...	21
Typhoid fever?	3	12	...	...	1
Does it run a longer course? ...	...	...	10	85	4
Is it more mild?	...	...	85	15	...
Are pulmonary complications more frequent, or less so?	14	68	...	...	8
Are cardiac complications more frequent, or less so?	21	52	...	...	12
Diphtheria?	7	11	...	...	4
More fatal, or less so?	8	44	...	...	26
Scarlet fever?	5	8	...	...	5
More fatal, or less so?	5	60	...	...	21
Measles?	4	11	...	...	4
More fatal, or less so?	4	52	...	...	28
In febrile conditions do you find higher temperatures?	..	...	30	67	5
Is convalescence after illness in general more prompt, or less so? ...	61	20	...	...	14
Are people recently from a low altitude more easily fatigued? ...	...	...	95	13	...
Are people long resident at a high altitude more easily fatigued? ...	...	...	24	79	...

The influence of high dry climates on tuberculosis has been so fully determined that it is not included in the foregoing list.

It would seem as if it should be possible to arrive at definite conclusions by comparison of statistics, as to the occurrence and mortality of pneumonia, typhoid fever, and the acute infectious diseases, and such an attempt was made. But those statistics obtainable were of such fragmentary and uncertain character that any conclusion based on them would have been of no real value.*

However, in case of pneumonia, some statistics have been reported which are worthy of careful consideration.

Dr. H. B. Whitney, of Denver, some years ago reported

* The careful system of recording vital statistics at present in operation with the Colorado State Board of Health will, from now on, give figures which can be used in making definite comparisons.

fifty-eight cases of acute lobar pneumonia occurring in his own practice during one winter, with a total of *thirteen* deaths, or a mortality of 22·5 per cent. Most of the cases were in adults, or had been, victims of a prevailing epidemic of *grippe*.
and nine of the thirteen deaths occurred in patients who were,

Dr. H. W. Hoagland, of Colorado Springs, kindly gives permission to read some statistics which he recently reported to the El Paso County Medical Society—a series of 587 cases of lobar pneumonia, occurring during two years in Colorado,†

	Altitude.	Cases.	Deaths.	Mortality.
†Denver	5,280 feet.	130	37	28·5 %
Colo. Springs ...	6,000 feet.	66	17	25·78 %
Salida	7,000 feet.	16	2	12·5 %
Cripple Creek ...	9,000 to 10,000 feet.	375	68	18· %
		587	124	

at altitudes between 5,000 and 10,000 feet, in which there occurred *124* deaths, giving a mortality of *21·11* per cent.

He compared these with *221* cases occurring in four Philadelphia hospitals during a corresponding time, of which *fifty-eight* died, yielding a mortality of *26·5* per cent.

He also compared the Colorado figures with *5,567* cases collected as follows:—

	Cases.	Deaths.	Mortality.
Philadelphia (above stated)	221	58	26·5 %
New Orleans Charity Hospital	3,900	1,100	28·25 %
Montreal General Hospital	1,012	206	20·4 %
London (Allbutt's Syst. Med.)	434	111	24· %
	5,567	1,475	

In these *5,567* cases there were *1,475* deaths, or a mortality of *26·5* per cent. There was thus a difference in favour of the Colorado figures of 5·4 per cent. in both comparisons.

Osler says: "Hospital Statistics show that the mortality ranges from 20 to 40 per cent."

Hoagland's cases were treated in hospitals at Denver, Colorado Springs, and Salida, with the exception of 375 cases occurring at Cripple Creek, almost entirely among miners, who are notedly alcoholic, and, for the most part, in cabins or shacks, with very unsanitary surroundings. So they cannot be considered as "picked cases."

This result of comparison is opposed to the prevalent idea, and also to that of sixty of the ninety-three physicians who expressed their opinions in the letters referred to.

No mention is made as to the length of residence of the Colorado cases, nor of the age, in *any* of the statistics. Undoubtedly pneumonia occurring in old people or those unaccustomed to a high altitude would be more fatal, and probably there is a limit in altitude above which the heart could not stand the extra burden of a pneumonia.

With reference to typhoid fever, *ninety-nine* seemed to think that it runs a shorter course at high altitudes, ten that it does not, while four saw no difference. The writer's impression is that more cases run a short, mild course than he used formerly to see in Massachusetts.

The former prevalence of so-called "mountain fever" is an indication of the relative frequency of mild cases of typhoid. On the other hand, the more general resort to Widal's test will undoubtedly stamp as typhoid many mild febrile illnesses which were formerly not recognised as such, in low altitudes.

The replies to the letter indicated a rather general impression of more frequent occurrence and more intractable nature of the functional nervous disorders at high altitudes, with an exception in the case of migraine.

The writer thinks he sees functional nervous cases with about the same frequency, and that they behave very much as they used to lower down. However, he believes that people

who are inherently nervous and had previously unstable nervous systems, often are made more nervous in high altitudes, supposing they have the same causes for nervous fatigue and worry that they previously did. He believes that he gives more bromides and sedatives than he used to, but there are many reasons for this other than altitude.

Colorado Springs is an exceptional place in some particulars. Very many invalids are there under protest, so to speak; are separated from their families and those dear to them; often are greatly worried over the financial burden which their stay entails; some are despondent because of forced changes in plans; others are homesick. Moreover, there is a good deal of trading in mining stocks, and this, with the rise and fall of the market, is undoubtedly a cause for a certain amount of nervous tension, as it would be in New York or London.

On the other hand, many invalids who are inherently nervous do extremely well physically and nervously. Very much of the difference in the two classes depends on *how* they live —whether quiet, restful lives out of doors, with proper hygienic *régime*; or one in doors, too much "in Society," with the strain that excesses of social pleasure entails.

Dr. Solly has aptly said that "nowhere is the invalid fool more surely or promptly punished for his folly than in Colorado."

The late Dr. Eskridge, a former Fellow of this Society and eminent as a neurologist, some years ago stated his conclusion, based on his own experience and that of representative men in Colorado, that "chorea was comparatively infrequent and of short duration in Colorado, and that the belief in high altitudes having a serious unfavourable influence on the disease was not justified by facts."

Dr. Howell T. Pershing, a neurologist at Denver, in stating the above conclusion, said he heartily concurred in it.

If it is true that neurasthenia and other functional nervous disorders are manifestations "of irritable weakness of the nerve centres, depending on the insufficiency of their nutritive pro-

cesses to repair the exhaustion caused by over-use, or by the depressing effects of auto-intoxication," and that our aims in treatment are "to improve nutrition, secure rest and recreation, and to prevent auto-intoxication" (Pershing), surely the therapeutic indications are as well and fully met in such a climate as that of the eastern foothills of the Rocky Mountains as anywhere.

Dr. Pershing, in refuting the belief that functional nervous disorders are more common in high altitudes, calls attention to the recognised belief that the favourable effects of high climates on pulmonary and other tuberculosis are principally due to an improvement in the nutrition of the body as a whole; and, it seems to me, his claim that "the climatic influence which strengthens the resistance of the whole body to tuberculosis also acts favourably on the nervous system" is sound logic.

He states that Dr. S. G. Bonney found that his cases of tuberculosis with complicating neurasthenia did nearly as well as the average; and that the nervousness generally improved at the same time as the pulmonary lesions.

The fact that the blood is richer in red corpuscles and hæmoglobin in a high altitude, he points out as another condition of unmistakable value to the neurasthenic.

The increased opportunity to be more in the open air, with its bright, cheering sunshine, either for out-door sports, or while resting, is of immense importance.

As to *insomnia*, it appears to be the case that most overworked, debilitated, anæmic individuals sleep better on coming to a high altitude; while the full-blooded, high-strung, nervous person sleeps better at sea-level. This is what physiology would lead us to expect.

It seems fair to claim that what has been said of some neuroses will, in the main, apply to all.

The *wind* and *dust storms*, and times of heightened electrical conditions, which occasionally occur at high altitudes, undoubtedly do increase nervousness and insomnia in most

people, but, in the writer's experience, these do not occur often enough to be of material consequence.

The writer believes that he sees rather less of so-called *biliousness* and digestive disorders than while practising at sea-level, though some people seem to be more prone to them. And he thinks he has observed that the latter class are those who are made nervously worse at high altitudes, and the former, those whose general nervous tone is improved and who live and conduct their affairs in a placid even-dispositioned manner.

As to the occurrence of *rheumatism*, *gout*, *lithæmia*, or *uric acid diathesis*, I will state, in a general way, that I find more frequent indications for the salicylates and drugs which are supposed to aid in elimination of uric acid; that there is more often an excess of urates in the urine; that chronic rheumatic affections, especially of a myalgic type, seem to me to be rather more frequent; while acute articular rheumatism seems less so.

No attempt will be made in this paper to discuss the pathology of these affections, but something will be said concerning the question of elimination at high altitudes.

In high, dry climates there is increased elimination of water and waste solid products by the skin and lungs. It is believed that the skin normally eliminates more, relatively, of solids than the lungs.

The skin is more active at warm, dry temperatures, while the lungs do more work when it is cold. So that in cold, dry weather, such as is usual in winter at high altitudes, the skin being less active, there is less free elimination of the waste solids. This throws on the kidneys the task of getting rid of more solids with an insufficient amount of fluids (granting that there is no increase in the fluids drunk). This is offered as one explanation for the greater frequency of gouty symptoms in winter.

In warm, dry weather, like that of the high altitude summer, the skin is very active and excretes a large amount of solids as well as fluids, so that the kidneys have less to do.

But in dry climates the fluid part of the perspiration is evaporated very rapidly, probably leaving on the skin much more solid refuse to clog the sweat-glands than would be the case if evaporation were less rapid and more of the perspiration absorbed by the clothing. This would diminish the elimination by the skin (unless frequent bathing were practised) and throw more work on the kidneys.

Now, if in the winter enough excess of fluids is drunk to keep the waste solids easily soluble, the kidneys will be able to keep up free elimination. Therefore, we are led to the inference that, if there are influences in high altitudes which tend to diminish elimination, this can be easily overcome by drinking more water and bathing more frequently.

It would seem that *convalescence after illness in general* is apt to be more prompt at high altitudes, because of the greater possibility of being in the open air and sunshine.

That people recently come from a low to a high altitude are more easily fatigued, is so definitely certain as to admit of no doubt. Ninety-five of 108 doctors reported that they found it so. This is a point of vital importance to tubercular invalids going to Colorado.

Not long ago the writer had occasion to call attention to it in a paper‡ in which he urged "instruct the invalid [before sending him to a high altitude] to rest and *keep quiet* after his arrival until someone competent to advise him considers it safe to begin to exercise; and then have his manner of life and hygiene directed from time to time according to his progress and condition."

Seventy-nine doctors believed that people long resident at a high altitude were not more easily fatigued than when lower; while twenty-four believed that they were. It has seemed to me that there is a capacity for doing rather more work, physical

‡ "Phthisis: Some Causes of Failure in its Climatic Treatment." *Boston Medical and Surgical Journal*, November 1, 1900.

and mental, in a short time, and without more fatigue, if the effort is not too long continued. But I am quite certain that prolonged, severe, nervous strain tires most people more. Whether this is true in regard to physical work, I do not feel at all sure.

DISCUSSION.

Dr. SEWALL: I would like to ask the doctor's authority for the statement made as to the elimination of urea through the skin in summer and winter and the reduced elimination in high altitudes?

Dr. FISK: I would like to point out the fact that camps like Leadville and Cripple Creek do not form a proper basis for such conclusions, since the conditions of life there are so different from the ordinary that they cannot be fairly considered in comparison.

Dr. SWAN: In regard to the elimination through the skin I think my authority is Dr. Solly's "Climatology." As to Leadville and Cripple Creek, it seemed to me that while considering the effect of altitude upon pneumonia, the conditions in these mining camps where the men were very alcoholic, and the sanitary surroundings surely not of the best, might fairly be considered in comparison with conditions in more wholesome localities.

Dr. FISK: They live very irregular lives, often going on prolonged sprees and sleeping out in the wet.

Dr. SWAN: But the mortality is lower than that reported at lower altitudes in pneumonia.

BRONCHIAL ASTHMA AND ALLIED DISORDERS: THEIR SUMMER TREATMENT.

BY BEVERLEY ROBINSON, M.D.

NEW YORK.

To some medical practitioners, I am glad to say, the existence of cases of purely nervous asthma, although admitted, is regarded as relatively very infrequent. The great majority of cases seen by us, in dispensaries, hospitals, and even in private practice, are already accompanied by evidences of bronchitis, acute or chronic, not to speak of the frequency of conditions which may or may not be considered as complications. This statement being admitted, I shall not take time to discuss the different theories of asthma. In the first place, you all know them as well as I. In certain cases undoubtedly, one theory seems the more rational, in another patient it is very unsatisfactory to explain signs and symptoms.

Asthma is a symptom of many allied conditions, as a rule; it is explained by none solely. At times, the nervous substratum, hereditary or acquired, is most pronounced; again, it is not evident even after considerable enquiry and research. The cause of the attack may be direct, sufficient and clearly defined; often it is distant, obscure, badly determined. What is true and admitted of all is the manifest indication to relieve acute dyspnœa when present, as rapidly as one can, provided always it is done rationally and without causing, immediately or subsequently, avoidable injury to the patient.

In general terms, an injection of morphine and atropine will

relieve very many urgent cases. There are, however, exceptions, and in one instance in my experience, it aggravated the symptoms in a marked degree. Inhalation of nitrite of amyl frequently also affords great and immediate relief. Here, again, I have known it on one occasion to give no relief, and within a brief period and despite active and repeated stimulation, the patient died. I might continue in this line, and speak of inhalations of chloroform, ether, chloride of ethyl, and other anæsthetics. Also, I might laud the effect in acute attacks, of inhalation of cigarettes, papers, powders, formed essentially from well-known narcotic or anti-spasmodic drugs. Sometimes they relieve in a remarkable and rapid manner. After a while, and although they were at first useful, they lose power in this respect, and cannot be counted upon even for solace. Of the numerous drugs which have been vaunted to lessen the suffering and shorten the duration from the acute attack, while diminishing its frequency and lessening its later intensity, none in my judgment is so valuable as iodide of potash. It may be given by itself, preferably in milk or junket, as a suitable menstruum and in moderate or large doses. In almost all instances where the suffering is acute or only moderate, it should be combined with Hoffmann's anodyne. Thus we obtain effects from the useful expectorant properties of the iodide and the stimulating and anti-spasmodic qualities of the ether compound at the same time. After all, however, the treatment which is most important is the preventive one, if possible, of the recurrent attacks, and to effect this we should, of course, consider all individual factors involved; but even then the influence of climate for good or for evil, is primary.

About this matter, there exist some received but lamentable errors. In the first place, it is stated that asthmatics do better at times in the city than in the country; that the more or less contaminated air of the former prevents or shortens their attacks. This I do not, cannot, believe, and certainly in a fairly wide experience, I have seen and heard nothing which proved it to

be true. No doubt there are rare instances where in a given locality, seemingly the most unfavourable, an asthmatic patient has had the experience of an attack being shorter, less violent than usual; or, indeed, not to have had one recur for months or years perhaps. When, however, these rare cases are thoroughly sifted, it will be found that the true solution of such singular or startling facts, resides in a matter easy of explanation in a satisfactory way. It is stated also that one place or another in the country is especially good for an asthmatic patient, just as it is affirmed that this or that spot is particularly favourable to sufferers from hay fever. My own experience, observation and reading, would prove in general that it is an erroneous belief. The place that suits a well man best, frequently suits an ill man best, but with asthmatic patients particularly, the individual search for this place must be made, and judgment about it only definitely fixed after several trials and much previous uncertainty. I have been in the habit, whenever I could properly do so, of sending my patients with catarrhal disorders of the respiratory tract, to Europe in summer. The complete change, the ocean trip, absence from all worry and care, were in my mind as elements most desirable to ameliorate a previous condition of disease, and thus to diminish on return home the probability of renewed attacks. Where the respiratory difficulty is pronounced and has resisted many methods of treatment, I consider a spa treatment of three to four weeks, advisable. If the digestive organs are notably impaired and the liver engorged and torpid, the mild alkaline springs of Homburg or Royat are useful, and even if abused, are not very detrimental to health like those of Carlsbad. In all rheumatic and gouty states combined with the conditions mentioned, these waters are also clearly indicated. On the other hand, where the respiratory tract is notably involved, and where the other conditions seem secondary, I have no doubt that certain sulphur springs, especially those of Aix-les-Bains, are more beneficial. I believe this, first because I believe the

local use of sulphur water atomised, or of the gases from it respired, is beneficial. Aside also, the advantages from baths, drinking the sulphur water, use of it locally in the form of sprays or vapours, I am of the opinion that the air itself of and around sulphur springs, is curative of most catarrhal diseases of the air passages. In those instances where patients cannot go to Europe in summer, I advise them to go to sulphur springs in the United States, preferably Sharon or Richfield, or to some region of the Adirondacks more or less elevated. The sea-shore in general does not appeal to me; and yet, for such patients, I have known those who have improved notably anywhere from Long Island to the Maine coast. The doctor and patient must here work in unison and find out the special spot suited to the latter's needs. As we know, there are several places in the White Mountain region which are very healthful and bracing, and are said to be especially well suited to hay fever sufferers.

In regard to other treatment in summer: what should we do with our asthmatics of bronchial type or those affected from an allied disorder? Should we continue to give them drugs or simply depend upon climate or spa treatment and *régime*, to do for them all that is desirable? Here, again, there is no absolute rule. We should, as I believe, do pretty much as we should do under similar conditions in the winter, and when the patient is at home or in some one of the health resorts of the south. What this treatment is I have shown in a certain measure already. In addition I might add that search should be intelligently made for any sinning agent or organ which evidently requires attention. Among men especially, the nose and stomach must be properly considered. If there be marked nasal obstruction from polypus, deviated septum, hypertrophy, suitable local interference should be instituted. If dyspepsia and gastric complications are present, judicious treatment should be tried. Among women, both nose and stomach must also be investigated, and inasmuch as the uterus and ovaries are fre-

quently at fault, perhaps some local treatment may there be required. What is far more likely is that the general nervous system need toning up in every way, and whenever this indication is judiciously attended to, it will be found that sufferers from asthmatic seizures are not rarely much benefited.

It is often true that despite all our well-meant efforts, these patients still remain great sufferers, and then they are too apt to become victims of soulless quacks who give them unwholesome drugs and drain their pockets. This is to be deplored, and also because many proprietary remedies for bronchitic asthma act through the respiratory passages, and when for example they are inhaled, by reason of irritating products of combustion, do real harm to parts which are relatively healthy. To those parts far removed, deep seated, where the occluded, thickened, inflamed bronchial tubes are found, and which are the real *fons et origo* of most signs and symptoms, here the inhalations rarely reach, and even were they appropriate and innocent, could only now and then be of any use. On the other hand, some of these inhaled substances are powerful narcotics and depressants and also local irritants. They deprive the healthy mucous membrane of its protecting epithelium; they depress and weaken many an organism, where a dilated heart, emphysematous lungs, and insufficient kidneys make their use wrong from every point of view, and not seldom dangerously threatening to the patient's life.

Almost all cases of bronchitic asthma which have lasted some years, and where the acute attacks have been at all severe, are accompanied with some dilatation of the right heart cavities. The cardiac walls are thinned, have lost power, and may be degenerated. Hence it is that too high mountainous elevations are to be avoided, and we should not be surprised when told by patients themselves that such has been their experience. On the other hand, I do not believe the near vicinity of fresh water lakes to be advantageous to these patients, or, as a rule, a very moist or fog-laden sea-shore atmosphere. Of course, all

marshy, badly drained, clayey or even very soggy ground should be strictly avoided; and these indications are to be particularly observed, because I still believe that malaria causes asthma, where anopheles cannot be the carrying agents. Much rest, simple food, good water, very gentle or moderate exercise are the indispensables of a sensible summer treatment for asthmatics. Spirituous drinks, tea, coffee, tobacco, should be indulged in only exceptionally, and when the symptoms appear to justify or call for their use.

We know how frequent digestive disturbances accompany bronchial asthma. The effect of a late or imprudent meal will frequently occasion an attack. Even in cases where the dyspnœa is continuous, it is much aggravated by even a slight attack of dyspepsia. While the evidences of stomachal derangement are often manifest, this is not invariably true, and sometimes it is only after close investigation or the use of such medicinal means as soda bicarb., subgallate of bismuth, or the employment of lavage, that we can definitely determine its presence. Where the deranged stomach is causative of an attack of asthma or of an increase of chronic dyspnœa, the beneficial results of a rational dietary and treatment directed to this organ, are shown very soon. In our summer treatment of asthma nothing is more important, therefore, than the effects produced upon the digestive organs. I have no doubt that climatic influences are powerfully felt here as elsewhere. But well prepared, simple and healthful food is also very essential, and of course the drinking water should be of absolute purity and recognised potability. If these two qualities be not present, far better to have the patient drink some favourably known bottled spring water. Despite the views of Haig and others, I believe only moderately in gout as a frequent, direct causative factor of bronchial asthma. I do not deny, however, that it may be present, and for this reason, in doubtful cases, would consider it advisable to limit the amount of red meat in the dietary and insist mildly on drinking water from a so-called

lithia spring. While limiting the quantity of butcher's meat, I should also eliminate from the dietary potatoes and other starches in excess, as undoubtedly they are oftentimes productive of much flatulence and stomachal distension in the weak and feeble from any disease.

It is a fact which all general practitioners observe, *i.e.*, the interdependence at times of eczema and other cutaneous disorders and asthma. If the cutaneous affection is improved, the asthma is occasionally worse; if the asthma improves, the eczema is more pronounced. The underlying factor in both instances is neurotic, the same eosinophile cells may now be found in the mucous secretion from the bronchial mucous membrane of the asthmatic or in the skin of patients suffering from prurigo. Arsenic, as Trousseau long ago pointed out, corroborated since by many other writers, will prove the most useful of all remedies in similar instances for dyspnœa on the one hand or itching on the other.

In many cases of bronchial asthma the question arises between drug treatment and a surgical operation. The operation indicated may be and frequently is in the nose. It occasionally refers to a misplaced uterus, an inflamed ovary, or an adherent prepuce as factors in the case. I stand to-day about where I did many years ago, always allowing for brilliant advances in the surgery of all special departments, which no one more cheerfully admits than I, viz., that while very rarely you may achieve a remarkable and enduring result in these cases by operative procedure, yet in the vast majority these desired results are not lasting. A time will come, sooner or later after the operation, when we are forced to ask *cui bono?* And the answer is more than doubtful from a favourable standpoint. Do I believe in mere drug treatment, so-called? I certainly do not, except in limited measure and with great regard for the large experience of many and for time-honoured testimony. As I grow older, and I believe more experienced, I am chary both of much medicine and much surgery.

Ignorance and enthusiasm do more harm in the long run than the contrary defects, perhaps, of scepticism and conservatism, which ever show a tendency to refrain. As I believe, a surgical operation is the opprobrium of surgery in the widest sense, just as a dose of medicine is the opprobrium of the healing art—the noblest and most beneficent of all the arts.

The luminous object to keep constantly in view, I believe, is what may ultimately proceed from a true prophylaxis of disease by the daily use of all hygienic methods. Already many of us recognise and teach this way of doing. Unfortunately, people are not as yet thoroughly educated to see the great wisdom of it and the inestimable results from a health point of view which would ultimately come to them by adopting it as their rule of guidance. To show how true it is as regards bronchial asthma I need only state what is true that the only cases of this kind which thoroughly and permanently recover in my experience, are those in young persons where secondary complications are as yet undeveloped, and where everything has tended to produce the best growth of an originally defective physical condition. A few of these cases are indeed the only ones where I would now be willing to recognise asthma as being a purely nervous disorder.

I might continue to read at length on this interesting topic. I have made no such attempt. I have merely endeavoured to point out a few leading thoughts proceeding directly from my own study and experience, which may serve I hope, to start an interesting and very profitable discussion at this season, when we all wish to know what is best to do with cases of bronchial asthma and allied disorders during the coming summer.

CLIMATE OF ARIZONA.

BY WILLIAM G. BURNS.
Section Director Weather Bureau.
PHŒNIX, ARIZONA.

GENTLEMEN,—I have been requested to present for your consideration some of the salient climatic features of Arizona. It is only possible, in order to confine myself within the allotted time, to refer to the climate of Arizona in a cursory way, for our climatic features are as varied as our topography is diversified, and within the borders of the Territory may be found all the gradations from the subtropical to the high temperate.

A brief reference to the topography of the Territory leads to a better understanding of its climatic features. The surface of Arizona is a succession of plains, plateaus, buttes, and mountains, extending step-like from sea level in the south-west to elevations of several thousand feet toward the north and east, attaining an extreme elevation in the San Francisco Peak that stands 14,000 feet above sea level. The term "plain" is used as descriptive of that portion of the Territory lying below the contour of 3,000 feet, and embracing the counties of Yuma and Pima, and portions of Maricopa and Pinal. The plateau, comprising more than half the Territory, is measured above the contour of 5,000 feet. The plains and plateaus are traversed by mountains having a north-west and south-west trend. In the region of the plains are situated the principal agricultural valleys, nurtured by water drawn from the Colorado and from the Gila and its tributaries. The physical features represent the rough

and rugged drawing in Nature's sketch book, and interspersed here and there, and ensconced between ragged mountains, are fertile and verdant valleys, oases in the far-reaching desert and man's reclamation of waste through water's magic touch.

It is by reason of this diversified topography that we encounter so many phases of climate in crossing the several contour lines. At any time of the year it is possible to move to a warmer or colder climate, and the range of mean temperature between the several places is always pronounced.

For the purpose of exemplification the climatic features of a few places, widely separated, have been selected. These places are named particularly because they afford ample accommodation for visitors. In southern Arizona we have Phœnix, Tucson, Oracle and Yuma; in northern Arizona—Prescott, Castle Creek Hot Springs, and Flagstaff. It cannot be gainsaid but that southern Arizona, all conditions considered, presents the finest winter climate of any section of the North American Continent. It only needs to be shown that we have in northern Arizona, at Prescott and at Flagstaff, a delightful summer climate, places where the mean temperature in the hottest month does not exceed 74° at Prescott, nor 68° at Flagstaff. These places are within the timber line and the air is charged with the soothing aroma of the surrounding extensive pine-forests. The Weather Bureau records show a mean temperature of 64·6° for Flagstaff for the three summer months of 1901. The mean of the maxima was 80·1° and of the minima 49·1°. The highest temperature recorded was 92° and the lowest 30°. There were 27 clear, 33 partly cloudy, and 32 cloudy days during the period. The total rainfall was 4·56 inches and the number of rainy days (days with ·01 or more of precipitation) was 28. Prescott for the corresponding period had a mean temperature of 70·5° mean maxima 88·7°, and mean minima 52·3°. The highest temperature was 102° and the lowest 33°. There were 48 clear, 36 partly cloudy and 8 cloudy days. The total precipitation was 5·29 inches and the number of rainy days was 21. This period

of healthful, invigorating climate is not strictly confined within the time named, but is likewise desirable for five or six months of the year.

Before we pass to a consideration of the climate of southern Arizona, your attention is invited to Oracle, a health resort about 40 miles north-east of Tucson. On account of its elevation it does not present the climate that its latitude would indicate, when compared with other places. It is somewhat colder in winter, its average temperature for December, January, and February being 45·8°, and it is cooler in summer, its average temperature for June, July and August being 78·8°. For the year 1901 it shows 269 clear, 58 partly cloudy and 38 cloudy days. The mean for the year was 62·7°; the highest temperature was 101° and the lowest 19°.

The winter climate of southern Arizona is justly famed, and I may state that the heat of the summer has not the terrors depicted by the uninformed. I speak of the climate of Phœnix and the Salt River Valley more in detail, because the data are at hand and more available, but it is only a type of what we find at Tucson and Yuma, the chief difference being a matter of elevation. In all climatic elements they practically agree except a slight increase in precipitation and wind movement with elevation.

Meteorologists recognise a path of storm movement and frequency along which there are pronounced changes in the weather conditions every few days. I refer to cyclonic and anti-cyclonic progressions, or, as described on Weather Bureau maps, areas of High and Low. This path of atmospheric activity is better defined in some sections than in others. Southern Arizona is not within this path of disturbance. Violent storms are infrequent and cold waves unknown. The weather is equable in the sense that there is slight change in the mean temperature from day to day.

It is not my purpose to engage your attention with a long array of figures. Data of this kind are better digested and

understood by personal inspection and study. But it is found necessary to present some information in figures. These are taken from the annual meteorological summary of the Phœnix station for the year 1901. The mean of the maxima for the winter months was 67·5°, and of the minima 40·2°; the highest temperature was 85°, and the lowest 24°. Our cooling process proceeds almost entirely from radiation, and there is a gradual fall of temperature from sunset to sunrise. The mean daily range was 27·3°. The range between day and night is great, but that is always an incident where cloudless skies obtain. Your attention is specially invited to the mean daily variability or change, or the difference in the mean temperature from day to day. This change averaged 2·8°, and indicates a great evenness of meteorological conditions and a lack of sudden and pronounced changes. During the winter we had fourteen days with a minimum below 32°. A mean temperature above 50° was recorded on 65 days, and a mean above 59° on 18 days. The mean relative humidity was 46 per cent. Professor Phillip B. Woodworth, of Lewis Institute, Chicago, who has been making a special study in mean temperature and moisture in the atmosphere as the source of differentiation in the development and temperament of man, says, "that a thermometer range of 65 to 70°, with an atmosphere saturated 45 to 55 per cent., unite in a condition that is ideal for man." Our winter days closely approximate these conditions. The precipitation (all rainfall) measured 1·89 inches. During this period there was bright sunshine for 669·8 hours, out of a possible 937·5, and expressed in terms of percentage the average was 72 per cent. This, however, was the lowest record made in the past seven years. There were 47 clear, 21 partly cloudy and 22 cloudy days; there were nine days on which ·01 inch or more of precipitation fell. Fog occurred on two days, and we have had only ten days with fog in seven years. The average wind movement was 3·8 miles per hour—a gentle, almost imperceptible breeze.

You have been shown only the meteorological conditions

Climatological Data for Phœnix, Arizona,

for the Year 1901.

Months	Temperature: Mean Dry Bulb 8 a.m.	Mean Dry Bulb 8 p.m.	Mean Wet Bulb 8 a.m.	Mean Wet Bulb 8 p.m.	Extremes: Highest	Extremes: Lowest	Mean Max.	Mean Min.	Mean Monthly	Normal	Mean Below 32	Mean Above 41	Mean Above 50	Mean Above 59	Mean Above 68	Mean Above 77	Mean Above 90	Precipitation: Total	Precipitation: Normal	Relative Humidity: Mean	Weather: Clear	Weather: Pt. Cloudy	Weather: Cloudy	Weather: .01 inch or over	Sunshine: Percentage of Possible	Wind: Average Hourly Velocity
January ...	43	62	38	48	75	24	66	40	53	49	0	30	23	3	0	0	0	0·43	0·57	47	15	6	10	2	63	3·5
February..	46	65	43	51	85	35	68	44	56	54	0	28	20	10	0	0	0	1·46	0·89	59	11	7	10	7	65	4·4
March.....	48	71	40	51	87	35	74	46	60	61	0	31	30	16	1	0	0	0·33	0·68	38	21	5	5	3	80	5·0
April	51	78	41	54	92	39	81	50	66	67	0	30	30	21	15	0	0	T	0·30	29	18	9	3	0	84	5·2
May.....	61	87	49	60	98	50	90	60	75	75	0	31	31	31	29	10	0	0·10	0·16	30	18	11	2	2	85	5·0
June.....	68	97	50	62	112	59	99	66	83	83	0	30	30	30	30	26	3	0·00	0·07	19	26	4	0	0	95	4·7
July.....	80	104	65	71	112	72	106	80	93	90	0	31	31	31	31	31	26	0·35	0·85	33	17	14	0	5	80	5·0
August	79	100	68	72	110	70	103	76	90	88	0	31	31	31	31	31	13	1·73	0·97	43	19	10	2	8	81	4·1
September.	68	95	54	64	105	53	98	66	82	81	0	30	30	30	30	24	0	T	0·54	28	28	2	0	0	95	4·1
October....	60	83	50	60	100	41	88	58	73	69	0	31	31	29	26	6	0	0·46	0·62	39	22	5	4	1	83	4·1
November	51	72	46	55	86	44	79	49	64	58	0	30	30	29	1	0	0	0·01	0·44	49	17	7	6	1	77	3·0
December.	40	62	32	45	80	24	68	36	52	53	0	28	22	5	0	0	0	0·00	1·12	32	21	8	2	0	87	3·5
Year...	58	81	48	58	112	24	85	56	71	69	0	361	339	266	194	128	42	4·87	7·21	37	233	88	44	29	81	4·3

obtaining during the winter months. We could go further and show almost as favourable conditions for six months, from October 15 to May 15.

I desire to touch briefly on a subject that is often discussed, relative to the effect of irrigation in increasing the humidity of the atmosphere in this locality. A drop of ink let fall into a hogshead of water is certainly there, but it would take a careful chemical analysis to make a determination. The water vapour evaporated from the irrigated fields adds to the humidity of the atmosphere, but when the small area under irrigation is considered with the adjacent desert region, and the great capacity of surrounding space for water vapour is taken into account, and the moisture content is so far from being satisfied, we conclude that it has a salubrious rather than a deleterious effect. During crop-growing seasons, when the water is spread over the greatest possible area, relative humidity as low as 3 per cent. has been measured.

No invidious comparisons have been made with other sections laying claim to climate having therapeutic qualities. An investigation of our presentation will show all we claim. With an extreme breadth from east to west of 335 miles, and an extreme length from north to south of nearly 400 miles, embracing an area of 113,000 square miles; with our snow-capped mountains of great elevation extending to sandy deserts at sea level; with our heavily timbered forests, our grassy plateaus and extensive deserts, they all unite in presenting varied meteorological features and climatic conditions.

It is not my province to discuss the requirements of medical climatology, nor the specific climatic conditions necessary for certain classes of disease, but the statement may be safely advanced that where the requirement is dry air and constant sunshine, that condition exists to an eminent degree within the borders of Arizona.

PART I.—REPORT ON MINERAL SPRINGS.*

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SULPHUR WATERS.

By sulphur waters is usually meant those in which the predominant gaseous ingredient is hydrogen sulphide, or, as it is commonly called, sulphuretted hydrogen. Other sulphides may and often do coexist, but usually not in sufficient quantity to classify the waters. The sulphurous gas may characterise any class of waters, and therefore the term "sulphur waters" should not be given a place co-ordinate with the terms "alkaline," "saline," and "acid," as it is in most classifications. A very little sulphuretted hydrogen will go a great way in classifying a spring water, but there is no reason why the solid constituents should be ignored and the gaseous constituents be given first place. Carbon dioxide is usually present in sulphuretted waters, for reasons to be stated farther on, and of course the waters may also be either thermal or non-thermal.

The source of the hydrogen sulphide is to be found in the reduction of the sulphates of the alkaline earths by organic matter, either under pressure or by heat or both combined. In the brines or sodic-muriated waters it may result simply from the action of organic matter, upon calcium sulphate in the presence of carbon dioxide. Besides the free hydrogen sulphide

* Submitted by the Committee on Mineral Springs: Dr. Albert C. Peale, Dr. Charles C. Ransom, and Dr. Guy Hinsdale, Chairman.

which exists, of course, in the gaseous form, there may be present other sulphides, sulphydrates, and thiosulphates (sulphates in which one atom of the oxygen in the water of the sulphuric acid is replaced by sulphur), and these waters must contain carbonates or alkaline carbonates. Hence we are apt to find them under the head of the alkaline-saline waters, and, as just stated, they are frequently sulphocarbonated. In all waters which are perceptibly sulphuretted the thiosulphates are probably present. Those waters most strongly alkaline usually contain the sulphides, and those feebly so the sulphydrates. The soluble sulphides are rather unstable and easily decomposed, and are rarely fully determined in mineral water analyses because a part of the necessary work of analysis must be done at the spring. The majority of water analyses are therefore confessedly incomplete so far as the estimation of the gases is concerned. It is probable that more careful work would determine the presence of carbon dioxide in most, if not all, of the waters in the following lists, and possibly in the waters of the second smaller list other sulphides would be found in addition to hydrogen sulphide.

It has always been more or less questionable whether waters containing only hydrogen sulphide, so far as sulphur compounds are concerned, produce any medicinal effects when used for drinking purposes. Some authorities hold that only such waters as contain other solid sulphides are physiologically effective, basing that opinion on the ground that the free gas taken internally in solution in the waters is rapidly thrown off from the body without producing any apparent effect; whereas if it is eliminated from sulphides already in the circulation its effect is both quick and powerful. Other writers are equally positive that the hydrogen sulphide, even when existing alone, has a therapeutic effect. The chief efficacy of the sulphuretted waters of Harrogate in England, and the white sulphur springs found in so many localities in the United States, has been referred to the presence in them of hydrogen sulphide. It must be

remembered, however, that small quantities of other non-gaseous sulphides may be, and are most likely, present in the waters, and may have escaped detection. If the presence of the solid sulphides is abolutely essential for a therapeutic effect, then the only true sulphur waters would be those containing such compounds. Such combinations are unstable, and the amount of sulphides in these waters are usually very small in proportion to the total solid contents.

Among typical foreign sulphuretted waters may be mentioned those of Aix-la-Chapelle, Eilsen, Baden, Nenndorf and Bagnéres-de-Luchon.

In the United States sulphuretted waters have a wide distribution, and there is scarcely a State that does not have within its borders a sulphuretted spring; but they are especially numerous in the mountainous portions of the country and where volcanic rocks are found. Therefore many of them are thermal.

In the first following table† the arrangement of the waters is in accordance with the amount of the contained sulphides, as stated in the various published analyses. The amounts supposed to be present in each case are given in the first column of the table. In some cases it is altogether probable that the amounts are too great, and if some of the analyses were revised and their elements recombined, some of the sulphides would be expressed as sulphates. Nearly half of the waters enumerated in the table are sulphocarbonated, *i.e.*, containing carbon dioxide as well as hydrogen sulphide. Were all the analyses complete this proportion would undoubtedly be greater. Most of the waters also fall into the class of alkaline-salines, which is in accordance with what has already been said as to the necessity of the presence of alkaline carbonates to hold the sulphides in solution.

This list is not intended to be complete, and as a matter

† Reprinted by permission from the author's contribution to vol. IX. of "A System of Physiologic Therapeutics." P. Blakiston's Son and Co., Philadelphia, 1902.

of course a complete list cannot be given in the absence of complete analyses. Many are well-known resorts. The character of the water is given in parenthesis after the name of the spring.

	Sulphides other than Hydrogen Sulphide, Grains in One U.S. Gallon	Hydrogen Sulphide, Cubic Inches in One U.S. Gallon	Carbon Dioxide, Cubic Inches in One U.S. Gallon	Total Solid Contents, Grains in One U.S. Gallon
Alpena Magnetic Spring, Michigan (sodic-muriated saline)	210·61	7·38	—	534·39
Congress-Hall Spring, Avon Sulphur Springs, New York (calcic-magnesic sodic-sulphated, and muriated alkaline-saline)	99·55	27·63	22·04	205·61
West Nashville Sulphur Springs, Tennessee (calcic-sodic muriated alkaline-saline)	11·85	5·84	—	122·55
Cascade Springs, Tennessee (calcic-sodic muriated saline	9·76	23·04	—	59·88
Ypsilanti Moorman Well, Michigan (sodic-muriated saline)	8·42	26·84	—	2256·26
Fernvale Springs, Tennessee (calcic-magnesic sulphated alkaline-saline)	8·22	16·64	—	73·84
Jones Sulphur Well, Tennessee (calcic-sodic sulphated alkaline-saline)	7·13	1·17	14·75	30·25
Hurricane Springs, Tennessee (calcic-sodic muriated alkaline-saline	5·86	1·16	14·26	43·75
White Sulphur Spring, El Paso de Robles, California (sodic-magnesic sulphated and muriated saline)	5·10	9·40	5·25	112·85
Sharon White Sulphur Spring, New York (calcic-magnesic sulphated alkaline-saline)	3·00	20·50	—	149·10
St. Helena White Sulphur Springs (No. 2), California (sodic-muriated saline)	2·65	6·15	—	36·69
Primm's Springs (No. 2), Tennessee (calcic-magnesic sulphated saline)	2·57	—	—	81·53
Florida Spring, New York (sodic-magnesic-muriated alkaline-saline)	2·19	3·76	32·17	48·39
Council Spring, Montesano Springs, Missouri (sodic-calcic muriated alkaline-saline)	1·97	1·43	34·30	393·77
St. Helena White Sulphur Springs (No. 6), California (sodic-muriated saline)	1·85	4·25	—	42·68
Richfield White Sulphur Spring, New York (calcic-magnesic sulphated alkaline-saline)	1·81	14·21	—	154·28
Thorn Spring, Montesano Springs, Missouri (sodic-calcic muriated alkaline-saline)	1·74	1·59	43·24	535·99
Chittenango Magnesic Spring, New York (calcic-chalybeate sulphated alkaline-saline)	1·68	5·62	19·44	153·35
Pearl Spring, Montesano Springs, Missouri (sodic-calcic muriated alkaline-saline)	1·64	1·76	44·14	530·94
Crisp Springs, Tennessee (calcic-magnesic sulphated alkaline-saline)	1·35	9·47	—	77·20

	Sulphides other than Hydrogen Sulphide, Grains in One U.S. Gallon	Hydrogen Sulphide Cubic Inches in One U S. Gallon	Carbon Dioxide, Cubic Inches in One U.S. Gallon	Total Solid Contents, Grains in One U.S. Gallon
Bath House Spring, Cherry Valley, New York (calcic-magnesic sulphated alkaline saline)	0·60		—	140·71
Elliotts' Well, Cass Co., Missouri (sodic-chalybeate alkaline-saline)	0·60	0·26	—	102·03
Eye Spring, Grayson Springs, Kentucky (calcic-magnesic sulphated alkaline-saline)	0·58	1·39	—	104·91
Powder Spring, Orkney, Virginia (sodic-calcic alkaline)	0·53	5·91	8·62	20·89
Tilford's Mineral Well, Tennessee (sodic-sulphated alkaline-saline)	0·45	Trace	14·00	36·16
Casco Spring, Montesano Sprirgs, Missouri (sodic-calcic muriated alkaline-saline)	0·43	1·60	43·20	541·62
Montesano Spring, Montesano Springs, Missouri (sodic-calcic muriated alkaline-saline)	0·34	1·40	64·43	538·58
Montebello Spring, Vermont (calcic alkaline)	0·32	—	—	37·60
McClelland's Well, Cass Co., Missouri (sodic sulphated alkaline saline)	0·12	Present	—	120·59
Powder Springs (Spring No. 3), Georgia (magnesic-calcic sulphated alkaline-saline)	0·05	75·00	—	21·36
Lebanon Thermal Spring, New York (calcic-magnesic sulphated alkaline-saline)	0·02	—	0·48	24·38

In the table next following the springs are arranged in order according to the amount of the contained hydrogen sulphide gas; only this and the carbon dioxide being here stated. Many more springs of this character might be included, but a sufficient number is given to show that sulphuretted waters are distributed according to their solid contents in all the classes with the exception of the alkaline class. The springs given in this table are those in which no other sulphides than that of hydrogen are mentioned as being present. It must be borne in mind, however, that, as already stated, other sulphides may coexist with the hydrogen sulphide and may have escaped detection, or may have been present in very small quantity. Other sulphuretted waters will be found in the table just preceding, and at the end of this report.

In comparatively few analyses are the gases estimated with accuracy, and in many it is simply stated that sulphuretted hydrogen is present or that it is "in excess," or, as in the case

of some of the California Geyser Springs and many other sulphuretted springs, the water is said to be "saturated" with it.

	Hydrogen Sulphide, Cubic Inches in One U.S. Gallon	Carbon Dioxide, Cubic Inches in One U.S. Gallon
Cold Sulphur Springs, Virginia (calcic-alumino-chalybeate) ...	253·00	5·65
Lane's Mineral Springs, California (magnesic-chalybeate sulphated acid)	105·00	—
Cullums Sulphur Spring, Alabama (sodic-potassic muriated alkaline-saline)	97·10	–
Talladega Spring, Alabama (sodic-calcic sulphated alkaline saline)	82.00	—
Clarks Riverside Mineral Spring, Michigan (calcic-magnesic-sodic sulphated and muriated saline)	40·76	—
Crocker Springs, Tennessee (calcic-sodic-magnesic sulphated alkaline-saline)	40·25	37·99
Mount Clemens Mineral Springs, Michigan (sodic muriated saline)	40·00	5·85
French Lick Springs, Indiana (calcic-magnesic sulphated alkaline-saline)	17·00	10·12
Anderson Springs, Bellmer Spring, California (calcic-sodic-magnesic alkaline-saline)	9·47	149·6
Anderson Springs, Sulphur Spring, California (calcic-sodic-magnesic alkaline-saline)	4·20	243·50

The following list, arranged alphabetically by States, gives some of the many sulphuretted waters of the United States in most of which the gas is not very exactly estimated. No attempt has been made to differentiate those which have been used as resorts or those the waters of which are utilised commercially. The frequent recurrence of the name "White Sulphur Springs" will be noted.

ALABAMA:—White Sulphur Springs.

ALASKA:—Sitka Warm Sulphur Springs.

ARKANSAS:—Black Sulphur Springs, Van Buren County; Dardanelle Sulphur Springs, Yell County; Sulphur Springs, Benton County.

CALIFORNIA:—Blanks Hot Sulphur Springs, Colusa County; Las Cruces Hot Springs, Santa Barbara County; Matilija Hot Springs, Ventura County; Montecito Hot Springs, Santa Barbara County; Ojai Hot Sulphur Springs, Ventura

County; Piedmont White Sulphur Springs, Alameda County; San Marcos Sulphur Springs, Santa Barbara County; Santa Rosa Hot Sulphur Springs, Sonoma County; Simmons Hot Sulphur Springs, Colusa County; Tassajara Hot Springs, Monterey County; Vallejo Sulphur Springs, Solano County; Warm Sulphur Springs, Kern County.

COLORADO:—Hartsel Hot Mineral Springs, Park County; Steamboat Springs, Routt County; Tomichi Hot Springs, Gunnison County.

CONNECTICUT:—Sulphur Spring near Litchfield, Litchfield County.

FLORIDA:—Newport Sulphur Springs, Wakulla County; Suwannee Sulphur Springs, Suwannee County; White Sulphur Springs, Hamilton County.

GEORGIA: — Catoosa White Sulphur Spring, Catoosa County; Oconee White Sulphur Springs, Hall County; White Sulphur Springs, Meriwether County.

IDAHO:—Warm Sulphur Springs, Idaho County.

ILLINOIS:—Perry Springs, Pike County; Ross Mineral Springs, Saline County.

INDIANA:—Eaton's White Sulphur Well, Crawford County; Hartford Sulphur Springs, Ohio County; Indian Springs, Martin County.

IOWA:—White Sulphur Springs, Scott County.

KANSAS:—Fort Scott Artesian Well, Bourbon County; Sulphur Springs, Cloud County.

KENTUCKY:—Chameleon Springs, Edmonson County; White Sulphur Spring, Olympian Springs, Bath County; White Sulphur Mineral Springs, Warren County; White Sulphur Well, Metcalf County.

LOUISIANA:—White Sulphur Springs, Catahoula Parish.

MAINE:—Boothbay Medicinal Spring, Lincoln County; West Newfield Spring, York County.

MARYLAND:—Carroll White Sulphur Springs, Alleghany County; Windsor Sulphur Springs, Carroll County.

MICHIGAN:—St. Clair Mineral Springs, St. Clair County; Wyandot White Sulphur Spring, Wayne County.

MISSISSIPPI:—Castalian Springs, Holmes County; Quitman Red Sulphur Springs, Clarke County; White Sulphur Springs, Jasper County.

MONTANA:—Boulder Hot Springs, Jefferson County; Livingston Warm Springs, Park County; White Sulphur Springs, Meagher County.

NEBRASKA:—Saratoga Sulphur Springs, Holt County.

NEVADA:—Golconda Hot Springs, Humboldt County; Mineral Hill Hot White Sulphur Springs, Eureka County; Sodaville Sulphur Springs, Esmeralda County; Whelan's White Sulphur and Mineral Springs, Eureka County.

NEW MEXICO:—Ojo Azufre, Bernalillo County; Stinking Springs, Valencia County; Warm Sulphur Spring, Taos County.

NEW YORK:—Columbia White Sulphur Springs, Columbia County; Messena Sulphur Springs, Onondago County; Yates Sulphur Springs, Madison County.

NORTH CAROLINA:—Blackwell's White Sulphur Springs, Buncombe County; Cleveland White Sulphur Springs, Cleveland County; Haywood White Sulphur Springs, Haywood County; Warm Springs, Madison County.

NORTH DAKOTA:—Devil's Lake Sulphur Springs, Ramsey County.

OHIO:—White Sulphur Springs, Delaware County; Wyandot Magnetic Well, Wyandot County.

OKLAHOMA:—Granite White Sulphur Spring, Greer County.

OREGON:—Sulphur Springs, Douglas County; White Sulphur Springs, Clackamas County.

PENNSYLVANIA:—Bedford Sulphur Spring, Bedford County; Kane Sulphur Spring, McKean County; White Sulphur Springs, Bedford County; York Sulphur Springs, Adams County.

SOUTH DAKOTA:—Wessington Springs, Jerauld County.

TENNESSEE:—Black Sulphur Springs, Grainger County; Hales Red and White Sulphur Springs, Hawkins County; Pickwick Red and White Sulphur Springs, Hardin County; White Sulphur Springs, Hamblen County; Yellow Sulphur Springs, Carter County.

TEXAS:—Duffaus Sulphur Wells, Erath County; Sulphur Springs, Hopkins County; White Sulphur Springs, Cass County.

UTAH:—Beck's Hot Sulphur Springs, Salt Lake County; Salt Lake City Warm Springs, Salt Lake County.

VIRGINIA:—Fauquier White Sulphur Springs, Fauquier County; Jordan's White Sulphur Springs, Frederick County; Montgomery White Sulphur Springs, Montgomery County; Roanoke Red Sulphur Springs, Roanoke County; Yellow Sulphur Springs, Montgomery County.

WASHINGTON:—Sulphur Spring, Garfield County.

WEST VIRGINIA:—Addison Sulphur Springs, Webster County; Blue Sulphur Springs, Greenbrier County; Columbia White Sulphur Springs, Greenbrier County; Greenbrier White Sulphur Springs, Greenbrier County; Green Sulphur Springs, Summers County; Grey Sulphur Springs, Monroe County; Red Sulphur Springs, Monroe County; Salt Sulphur Springs, Monroe County.

WYOMING:—Cascade Creek Sulphur Springs, Yellowstone National Park; Rawlins Sulphur Springs, Carbon County; Sulphur Springs near Camp Brown, Fremont County.

PART II.—MINERAL WATER RESORTS.*

BY GUY HINSDALE, M.D.
PHILADELPHIA.

(a) SULPHUR WATERS.

NEW YORK.

RICHFIELD Springs, situated on Lake Canadarago, sixty-five miles west by north of Albany, and 1,800 feet above sea-level, is a resort popular since the early part of the last century by reason of the great natural beauty of its surroundings and the therapeutic virtues of its sulphur waters. It has excellent hotels, and the bath-house in connection with the springs is thoroughly equipped, containing sixty-seven rooms for sulphur baths, besides Russian and Turkish baths; inhalation rooms for the treatment of bronchitis and catarrh; electric rooms, douche rooms, and a sun-bath. The waters are heavily charged with sulphuretted hydrogen, and contain 112 grains of calcic sulphate in a gallon. There are also iron and magnesia springs. The waters are useful in insomnia from nervousness, or from overwork, in stomach disorders, and especially in cases of rheumatism and gout.† In the treatment of gout, immersion or tub-baths at temperatures of from 98° to 102° F. are given for from eight to twelve minutes. The internal use of the water is also of great value. Massage, hot-air treatment, and static electricity are also available at Richfield Springs.

* For further notes on American Mineral Springs, and for data on Canadian Climates and Resorts, see contributions by the author to "A System of Physiologic Therapeutics," vols. iv.-ix. P. Blakiston's Son, & Co. Philadelphia, 1902.

† See articles by C. C. Ransom, M.D., "Transactions of the American Climatological Association," vol. viii. p. 154, and vol. xvii., 1901.

Sharon Springs, in the central portion of Eastern New York, are situated in a valley 1,200 feet above the sea. These springs are known as the White Sulphur, the Gardner Magnesia, and the "Eye-water" Spring. They are used internally and externally, and have been employed for almost one hundred years. Commodious and well-equipped bath-houses have recently been erected.

Clifton Springs, in Ontario County, 617 feet above sea-level, are situated midway between Geneva and Canandaigua. The waters contain sulphur and carbonic acid gas and resemble the Sweet Briar White Sulphur Springs of West Virginia. They are five in number, and contain moderate quantities of sodium, magnesium, and calcium sulphate. There is a sanatorium of good repute, with a staff of eight physicians and accommodations for 450 persons. It is open throughout the year.

Michigan.

Mount Clemens is much frequented for its mineral springs. These are strong brines, sulphuretted. They are diluted for both external and internal use, and have a reputation for the cure of chronic rheumatism and neuralgia. The springs are twenty miles north-east of Detroit, and 340 miles from Chicago on the Grand Trunk Railway; there are good hotels. St. Clair Springs, on the St. Clair River, fifty miles by steamer from Detroit, has a superior hotel open all the year, and all the attractions of a well-equipped health and pleasure resort. There is a strongly muriated earthy sulphuretted water, useful in the strumous diathesis, and a gaseous alkaline muriated table-water, beneficial in digestive disorders and chronic nephritis.

West Virginia.

The typical southern watering-place is Greenbrier White Sulphur Springs, in Greenbrier County. It has been used for over a century, and is characterised by a quaintness and tone of southern elegance and comfort scarcely to be found else-

where. Various improvements, including a new water-supply, sewerage system, and conveniences which are not always found in old-fashioned southern watering-places, make it a representative resort. The springs are on the main line of the Chesapeake and Ohio railway at an elevation of 2,000 feet, close to the Virginia boundary. The surrounding mountains have an elevation of 3,500 feet, and belong to the Alleghany system. There is a heavy growth of oaks, maples and pines. The locality is especially suitable for invalids or delicate persons during the spring, summer and autumn. It is rarely oppressively hot and is generally cool morning and evening. There are sulphur and chalybeate springs. The sulphur spring contains in each gallon: calcium sulphate, 67 grains; magnesium sulphate, 30 grains; magnesium chloride, 0·8 grain; calcic carbonate, 6 grains; carbon dioxide, 11 cubic inches; hydrogen sulphide, 0·27 inch. The flow is thirty gallons a minute. The chalybeate spring contains carbonate of iron. The sulphur water is used internally for affections of the kidneys, liver and skin. The baths, from the same source, consist of Turkish, Russian, Roman, spout, and Nauheim. Massage is also given. The waters seem to have a beneficial effect, in connection with the advantages of climate, in hay fever, chronic nasal catarrh, asthma, and bronchitis; and when the hot sulphur baths are used, rheumatism, gout, and malaria are favourably influenced. There is a swimming-pool.

There is a great deal to entertain the visitor. The hotel is very large and accommodates 1,200 persons. There are rows of cottages near the hotel bearing the names Baltimore Row, Georgia Row, South Carolina Row, Florida Row, Alabama Row, which show the localities of patronage; there are frequent balls, horse races, and other diversions that make the resort exceedingly popular.

Addison Sulphur Springs in Webster County, containing 377·32 grains of sodium chloride and 19·36 grains of calcium sulphate; Greenbrier White Sulphur Springs, in Greenbrier

County, having 78·35 grains of calcium sulphate and 35·42 grains of magnesium sulphate; Red Sulphur Springs, in Monroe County, with 5·25 grains of sodium cabonate and 4·14 grains of sodium sulphate; Salt Sulphur Springs, in Monroe County, the "Old Spring" containing 84·9 grains of calcium sulphate and 22·36 grains of sodium sulphate in a gallon of water.

Virginia.

Jordan's White Sulphur Springs (1,200 feet) are alkaline sulphuretted. The water is useful in the treatment of gout and rheumatism. Accommodations and bathing facilities are good. The resort is pleasant in summer.

In Fauquier County, Fauquier White Sulphur Springs (1,000 feet) are pleasantly situated in a beautiful and quiet region near the Rappahanock River. The resort is well sheltered, so that invalids can be much out of doors at any time of year. The walks and woods are attractive. The waters are alkaline chalybeate, and are of use as a diuretic and in the treatment of neurasthenia and of menstrual disorders due to anæmia.

Montgomery White Sulphur Springs, in Montgomery County, with Roanoke Red Sulphur Springs, in Roanoke County, containing 6·54 grains of calcium carbonate and 3·04 grains of sodium sulphate; Yellow Sulphur Springs, in Montgomery County, having 63·3 grains of calcium sulphate and 21·09 grammes of magnesium sulphate in a gallon of water.

Georgia.

Warm Springs, in Merriweather County, at an altitude of 1,800 feet, south of Atlanta, have a temperature of 95° F. There are also in the same locality, yellow and red sulphur, chalybeate, and other springs that have acquired a considerable reputation in Georgia and the neighbouring States for the cure of skin diseases, rheumatism, and gout. The Indian Springs, in Butts County, between Atlanta and Macon, are sulphurous and laxative, and efficacious in jaundice, rheumatism, and

dyspepsia. They contain about seventy grains of magnesium sulphate to the pint, being thus the strongest of the kind in the United States.

Indiana.

French Lick Springs are situated in Orange County, 279 miles from Chicago and eighty miles from Louisville, on a branch of the Chicago, Indianapolis, and Louisville Railroad. The springs are in a valley, amid attractive surroundings. The Pluto Spring, discharging eighty gallons a minute, is a saline sulphur water, carbonated. One gallon contains of magnesium sulphate, 66 grains; calcium carbonate, 40 grains; magnesium carbonate, 52 grains; calcium chloride, 32 grains; sodium chloride, 141 grains. This spring is used in the treatment of chronic affections of the liver and for dyspepsia. The water is concentrated and used in smaller quantities, to be diluted for internal use. It acts as a hydragogue cathartic. It is useful in obesity. The Proserpine Spring is a medium strength water and used locally for eye and nose affections and for the skin. The Bowles Spring is a mild, diuretic water. The Bath Spring is a strongly alkaline water, unsuitable for drinking, but useful in the treatment of rheumatism and affections of the skin. There are good facilities for bathing; Turkish, Russian, electric, mud, sulphur, and shampoo baths are given. The natural temperature of these waters is 55° F.

Kentucky.

Blue Lick Mineral Springs, near Carlisle, Nicholas County, Kentucky, have muriated sulphur waters of moderate strength heavily charged with hydrogen sulphide and carbon dioxide. They contain 79 grains of solid contents per gallon, of which 64 grains consists of sodium chloride. The water is used successfully in the treatment of dyspepsia, gout, chronic constipation, rheumatism, and cutaneous diseases.

(*b*) THERMAL WATERS.

Virginia.

Hot Springs (2,300 feet), on a branch of the Chesapeake and Ohio Railway, fourteen and a half hours distant from New York, has in recent years come to be the best equipped and most fashionable of the southern watering-places. The hotels are well kept, and are as popular with pleasure-seekers as with those who go for the medicinal virtues of the springs. The Virginia hotel provides first-class accommodations, and there are ten new cottages. The New Homestead Hotel and the bathing establishments are luxurious buildings with every modern appliance. There is a casino, and there are golf links and a choice livery. Fox-hunting is a favourite sport at the Springs. The springs are used successfully for the relief of chronic rheumatism and gout. The Warm Springs are about five miles, and the Healing Springs four miles, distant. Not far away are Millboro (2,000 feet), with weak gaseous alkaline sulphurous waters.

North Carolina.

The Hot Springs of North Carolina are in the western part of the State, at an elevation of 1,325 feet. The air and soil are dry, and there are no fogs nor high winds except on the mountain tops. The diurnal range of temperature is small. There is one comfortable hotel and a number of inexpensive boarding-houses. The Mountain Park Hotel is open all the year. There is a modern bath-house with sixteen separate pools. The springs are twenty in number and are famous through the south for the treatment of rheumatism, and rival the Hot Springs of Arkansas. They are thirty-five miles west of Asheville, near the Tennessee line, and are on the line of the Southern Railway.

Arkansas.

Hot Springs (425 feet), in the Ozark Mountains, lies a valley running north and south. There are seventy springs with

temperatures ranging from 76° to 148° F. They contain above fifteen grains of solid constituents, chiefly calcium carbonate and silica, in a gallon. Hotel and other accommodations are good, and there are many physicians. It is best to direct patients to a physician one knows—at least by reputation—and trusts. This popular resort is owned by the United States Government, and leased to the various tenants. The income is applied to the improvement of the reservation, a tract of 911 acres. The quantity of water distributed to each bath-house is scrupulously controlled, and extortion is prevented by the schedule of charges approved by the Secretary of the Interior. There is a free government bath-house, a most important institution and of great benefit to the indigent sufferers. There is a hospital for the officers and enlisted men of the army and navy.

The springs are used chiefly in the treatment of syphilis and rheumatism, and with excellent results. Syphilitics are subjected to "mercury by inunction most unsparingly, and potassium iodide internally in enormous doses," and, according to E. L. Keyes, this is just wherein the value of the springs seems to lie. A cure is effected even in desperate cases of late syphilis by means of the hot baths and the internal use of the water, which enable the patients to bear the drugs in greatly increased quantities. Broken-down, cachetic patients whose stomachs refuse to tolerate a sufficiently high degree of specific medication at home should be sent to Hot Springs.

Patients going to Hot Springs after a prolonged mercurial course at home sometimes develop ptyolism after a number of baths, showing that the waters have an influence in eliminating the drug.

The Potash Sulphur Springs (650 feet), six miles east of the Hot Springs, contain, besides sulphuretted hydrogen, magnesium and sodium sulphates and calcium and magnesium bicarbonates. There are limited hotel accommodations. Fogs

occur during the winter and spring, and high winds are common at that season.

New Mexico.

The Las Vegas Hot Springs are seven miles from Las Vegas in a sheltered spot. The waters contain moderate quantities of sodium chloride and sulphate. The Montezuma is an excellent hotel, and is probably the best place for the patient with means. There is a large sanatorium conducted on the hotel and cottage plan. The mud-baths are useful in the treatment of rheumatism.

South Dakota.

Hot Springs, on the southern border of the Black Hills, is at an altitude of 3,450 feet, the mountains rising 1,500 feet higher. The climate is cool and bracing, and there is a great diurnal and annual range of temperature. The relative humidity is about 60 per cent., and the skies are generally clear. The annual rainfall varies between 11 and 17 inches. The dryness of the air is such that beef killed and cut into pieces for handling may be hung in the open air and will be preserved perfectly. There is little snowfall, and whatever falls is generally dissipated by the chinook winds. There are about seventy-five mineral springs, with temperatures from 86° F. to 96° F. They contain sodium, potassium, magnesium, and calcium sulphates, calcium chloride, and magnesium chloride, with carbonates and phosphates. There is a plunge bath, 50 by 250 feet, with a constant temperature of 96° F. There are ten hotels and a few cottages. Access is by the Chicago and North-western Railroad, in about thirty-three hours from Chicago. The chief advantages of this resort are for sojourn of those suffering with pulmonary and bronchial affections, and for the treatment, by baths, of patients having subacute and chronic rheumatism.

Wyoming.

Rawlins' Sulphur Springs, in Carbon County, having 19·28 grains of calcium sulphate and 18·23 grains of magnesium sulphate in a gallon.

California.

Agua de Vida Springs (Upper Spring), in Alameda County, containing 17·5 grains of sodium sulphate and 11·92 grains of calcium carbonate in a gallon of water; Anderson Mineral Springs, in Lake County, with 20·4 grains of calcium carbonate and 16·95 grains of magnesium sulphate.

(*c*) LITHIA WATERS.

Massachusetts.

The Ballardvale Lithia Spring, near Exeter, Massachusetts, is the strongest lithia spring in the United States. It contains 22 grains of lithia salts per gallon.

New Hampshire.

The Londonderry Lithia Spring contains 7·29 grains of lithia salts per gallon.

New York.

Lithia salts are found in all of the seventeen Saratoga springs ranging from 1 to 11·45 grains per gallon, the largest percentage occurring in the Hathorn Spring. In these waters, however, chloride of sodium is the predominating element.

Pennsylvania.

Cambridge Springs, in Western Pennsylvania, on the Erie Railroad, fourteen miles from Meadville, and about sixteen hours from New York, is a favourite resort for the people of Pittsburg, Cleveland, and Buffalo, on account of its mineral springs. The springs are of various kinds—chalybeate, calcic, and contain magnesia and lithia. They are of value in diseases of the

stomach, liver, urinary organs, and in general hyperacidity. The hotels are large and well kept. The Hotel Rider, the Hotel Riverside, and the Highland Hotel afford good accommodation; the first of these is open all the year, and has accommodations for 600 guests.

VIRGINIA.

Powhatan Lithia and Alum Springs are in Powhatan County. Otterburn Magnesia and Lithia Springs are in Amelia County. Colemanville Mineral Springs, in Cumberland County, are weak alkaline chalybeate and alkaline earthy. Farmville Lithia Springs (550 feet), in Prince Edward County, are seventy-two miles south of Richmond. The region is historic; the climate pleasant in summer and mild in winter. The water is gaseous, alkaline, sulphated, with 3·76 grains of lithium bicarbonate in a gallon. It is widely sold and is useful in the treatment of gout, gouty dyspepsia, nephritis, and renal and vesical calculus. Buffalo Lithia Springs (150 feet), Mecklenburg County, are gaseous, alkaline, earthy, sulphurous. Spring No. 2 contains lithium carbonate, about 2·25 grains in a gallon. The resort is pleasant from June to October, and has a well-equipped bathing establishment.

In Augusta County, near Staunton, a pleasant and prosperous little town in the beautiful valley just north-west of the Blue Ridge, are the Virginia Magnesia Lithia Springs, and the Virginia Waukesha Lithia Springs.

GEORGIA.

The Bowden Lithia Springs, at an altitude of 1,200 feet, are one hour distant from Atlanta on the Georgia and Pacific Railroad. They contain a large quantity of bromin,‡ and are decidedly antacid and diuretic.

‡ According to N. A. Pratt, Chemist, Atlanta, in one gallon there are: Magnesium bromide, 15·23 grains; potassium bromide, 5·29 grains; lithium bicarbonate, 1·67; magnesium iodide, 0·73 grain; calcium sulphate, 20·21 grains; sodium chloride, 124·49 grains.

Indiana.

Mudlavia is located at Kramer, near Attica, Warren County, Indiana, 120 miles from Chicago on the Wabash or Chicago and Eastern Illinois Railroad. The resort is valuable on account of its mud-baths and water, which contains sodium, magnesium, lithium, and calcium salts and silicon. Analysis shows 20 grains of solid constituents in a gallon. The mud is applied over the body of the patient, after which he bathes in the lithia water. The treatment is said to be successful in rheumatism, gout, sciatica, eczema, and in the reduction of obesity. There are good accommodations, with a modern bath-house and competent medical supervision.

Obituary.

WILLIAM WARING JOHNSTON, M.D.

It is my sad duty to recall your attention to the death, during the past year, of one of our most earnest and valued members, William Waring Johnston, of Washington, D.C.

To those who know Dr. Johnston as we know him, it must be evident that words are all but useless in attempting to convey any idea of the personality of this great and good man. Beloved alike by his associates in the profession and by those with whom he sustained the relation of family physician, it is indeed lamentable that we are called upon to mourn the loss of one who had endeared himself to the community at large by his unselfish and intelligent devotion to his calling, and his general interest in all that concerned the good of humanity.

William Waring Johnston was born in Washington, D.C., in 1843, and died suddenly of the affection called the physician's disease, angina pectoris, March 21, 1902, at Atlantic City, N.J., where he had gone for rest and recuperation after a slight illness. He studied medicine at the University of Pennsylvania, graduated in 1865, and served as interne in Bellevue Hospital for one year. Later he studied at Edinburgh and Paris, and on the death of his father, Dr. Wm. Poynton Johnston, Professor of Obstetrics in Columbian University, he became the Professor of the Theory and Practice of Medicine in the same institution. He has been President of the old Clinical Pathological Society, Medical Society of the D.C. Medical Association of the D.C., and the Washington Obstetrical and Gynæcological Society. He was consulting or attending physician at the Children's Garfield Memorial, University, Providence, the Asylum, United States, and Emergency hospitals, Central Dispensary and Women's Clinic.

As a writer Dr. Johnston was accepted as an authority on those subjects to which he devoted much of his time. His works on the investigation of intestinal diseases are classical. Specially valuable are the result of his studies in typhoid fever, and his conclusions so concise that they have secured a general acceptance by the profession.

As a teacher Dr. Johnston had endeared himself to every student who had the privilege of hearing him teach those careful methods of diagnosis for which he was famous. Never did he fail to influence his students by his quiet spirit of helpfulness and sympathy.

In addition to the many professional demands made upon his time, he was ever ready to enter upon any municipal plan which had for its object the control of preventable diseases, and his efforts in this direction have greatly improved the sanitary conditions of the district. For all this his reward was as nothing. To our credit it may be said that we can point to such a man and say from our hearts—that man was at the head of his profession. Such a life of generous devotion will never be forgotton.

Roland G. Curtin.

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